NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA

For Immediate Release
Monday, November 9, 1959

AMES REORGANIZATION EMPHASIZES GROWING SPACE RESEARCH

The accelerating pace of research in many phases of space science is reflected in a realignment of the organization of NASA's Ames Research Center at Moffett Field, Dr. Smith J. DeFrance, Director, announced today. Major changes include the appointment of a second assistant director of the Center and a regrouping of research branches under five research divisions. Research was previously organized under four divisions.

Mr. H. Julian Allen, 769 Melville Avenue, Palo Alto, who originated the blunt-nose concept for protecting re-entry vehicles against destructive heating at extreme speeds, has been named an Assistant Director of the Research Center. Mr. Russell G. Robinson, 10702 Mora Drive, Los Altos, who has been Assistant Director since January, 1950, and Mr. Allen, will share between them the responsibility for administering the scientific programs of the Center's major research divisions.

The divisions established by the realignment are:

Aero-Thermodynamics Division, reporting to Mr. Allen.

Full-Scale and Systems Research Division, reporting to Mr. Robinson.

Instrumentation Division, reporting to Mr. Robinson.

Vehicle-Environment Division, reporting to Mr. Allen.

In addition, the Unitary Plan Wind Tunnel Division reports to Mr. Robinson.

Head of the new Aero-Thermodynamics Division is Mr. Robert M. Crane, 325 Langton Avenue, Los Altos.

The Full-Scale and Systems Research Division will be headed by Mr. Charles W. Harper, Moody Road, Los Altos.

Mr. James A. White, 11567 Crooked Creek Drive, Los Altos, will be head of the Instrumentation Division.

The Unitary Plan Wind Tunnel Division, under the leadership of Mr. Ralph F. Huntsberger, Jr., 2205 Waverly Street, Palo Alto, continues without change in the new structure.

Selected to head the new Vehicle-Environment Division is Dr. Alfred J. Eggers, Jr., 13870 Cicerone Lane, Los Altos Hills.

As head of the Aero-Thermodynamics Division, Mr. Crane will be responsible for the research activities of the Supersonic Free Flight Wind Tunnel Branch, the Heat Transfer Branch, the Fluid Mechanics Branch, the Trisonic Aerodynamics Branch and the Theoretical Branch.

Work of the Full-Scale and Systems Research Division under Mr. Harper, will include the 40- by 80- foot Wind Tunnel Branch, the Flight and Systems Simulation Branch, the Operations Branch, the Dynamics Analysis Branch and the Guidance and Control Branch.

In the Instrumentation Division, Mr. White will supervise the following branches: Vehicle Instrumentation Research Branch, Facilities Instrumentation Research Branch, Electronic Machine Computing Branch, and the Electronic Instrument Branch.

Work of the Unitary Plan Wind Tunnel Division under Mr. Huntsberger is accomplished by the 8- by 7- Foot Supersonic Wind Tunnel Branch, the 9- by 7- Foot Supersonic Wind Tunnel Branch, the 11-Foot Transonic Wind Tunnel Branch and the Unitary Operations Branch.

The Vehicle-Environment Division, under Dr. Eggers' direction, will include the Physics Branch, the Entry Simulation Branch, the Structural Dynamics Branch, the 3.5 Foot Hypersonic Wind Tunnel Branch and the Hypervelocity Ballistic Range Branch.

Dr. DeFrance said the changes in organization will be effective from November 15, 1959. He indicated that two of the Ames Research Center facilities, the 14-Foot Transonic Wind Tunnel and the 10- by 14-Inch Supersonic Wind Tunnel, will be placed on a stand-by basis because the increasing load of space research has lessened the demand for their use.

NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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MOFFETT FIELD, CALIFORNIA
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Ames 62-28

FOR RELEASE MONDAY, OCTOBER 29, 1962 October 26, 1962

NEW APPOINTMENTS AT AMES RESEARCH CENTER

Six National Aeronautics and Space Administration scientists and technicians have been appointed to supervisory positions at Ames Research Center, Dr. Smith J. DeFrance, Director of the Center, announced today.

Raymond E. Braig, who lives at 1913 Newell Road, Palo Alto, was promoted to Chief of the Technical Services Division. He will be responsible for technical support of the research facilities at the Center. During much of his 22-year career at Ames, Mr. Braig has been involved in the flight support operations of research aircraft.

Dr. Richard S. Young was appointed Chief of the Life Synthesis Branch. He will supervise research aimed at the detection and study of extra-terrestrial life, and the effects of space environments on living systems. Dr. Young lives at 1001 Payette Drive, Sunnyvale.

Dr. John R. Spreiter was appointed Chief of the Theoretical Studies Branch. He will direct the Center's research in space physics. The former Stanford University instructor resides at 11541 Herman Way, Los Altos.

Theodore R. Smith, who lives at 1542 Alta Glen Drive, San Jose, was

- MORE -

promoted to Chief of the Model Construction Branch. He will coordinate the construction of models of various spacecraft shapes for testing in the Center's 41 testing facilities.

William Rodgers was appointed Chief of the Transportation Branch. He will supervise the scheduling, servicing, and repair of the Center's vehicles.

Dr. John T. Howe was appointed Assistant Chief of the Physics Branch. He will assist in supervising the provision of basic physical data in astronautical calculations, and will pursue his specialities of research in the fields of gas dynamics and heat transfer.

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Ames 62-28

X Ames

NEWS RELEASE

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Ames 62-38

FOR IMMEDIATE RELEASE November 16, 1962

FUTURE CONSTRUCTION AT AMES REVEALED

Construction of four space research facilities, totaling over $14 million, has been authorized the National Aeronautics and Space Administration's Ames Research Center for Fiscal Year 1963.

The facilities will include a laboratory for biosciences, a space flight guidance facility, which will simulate missions to the moon and planets, a radiative heat system for the Center's Mass Transfer Facility, and a helium tunnel capable of producing an air flow fifty times faster than the speed of sound.

The bioscience laboratory will provide research facilities for the Center's rapidly expanding life sciences activities. Investigations of basic biological phenomena in space, as well as studies of environmental and bioengineering problems required for manned space flight will be carried out with this in-house capability. Ames scientists will perform studies in the fields of genetics, radiobiology, immunology, the detection of life on other planets, and environmental physiology at the new facility. Its cost is authorized at $924,000.

Research to obtain the information necessary to the integrated design of the guidance, stabilization, control and crew support systems in advanced manned spacecraft will be conducted in the guidance facility. It will consist of a

- MORE -

three-man capsule with appropriate systems and equipment, a combined analog and digital computer, and a rotating centrifuge to drive the capsule. Authorized cost of the facility is $9,790,000.

The radiative heat system will permit Ames scientists to investigate the intense heating to which a manned vehicle entering the earth's atmosphere from a lunar or interplanetary mission will be subjected. Sections of complete heat shields, including the ablation material layer, the insulating layer, and the back-up structure will be tested. One-and-one-half million dollars has been authorized for the project.

The new Ames Mach 50 helium tunnel will almost double testing capabilities for fixed models. Present facilities of this type are limited to twenty-six times the speed of sound. The tunnel will be used to complement the existing hypersonic free-flight facility, which uses gun-launched models to obtain fifty times the speed of sound. Its cost is authorized at $2,225,000.

The Ames Research Center is one of nine major NASA Centers throughout the country. Scientists and engineers at Ames are making important contributions to NASA's programs in the disciplines of physical sciences, life sciences, and space sciences.

In the physical sciences they are investigating re-entry from space, aircraft and space vehicle stabilization and control, flight dynamics, vehicle and meteoroid impact studies, and vertical and steep takeoff and landing (VTOL/STOL) aircraft research.

The detection and study of extraterrestrial life, and problems associated with engineering psychology are approached by the life sciences group.

In space sciences Ames designs experiments to be included on board scientific

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satellites and space probes. The fields of solar physics, planetary environments, and geophysics are also studied.

For the manned lunar landing program the Center is performing wind tunnel studies on the crew capsule, the escape tower, the forward portion of the launch vehicle, and combinations of the three units. Studies are also being conducted on optical instrumentation for the lunar mission; space vehicle attitude control; influence of crew station design on performance of capsule guidance, control, and navigation tasks; and pilot-operated attitude stabilization and control systems.

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Ames 62-38

X Ames

NEWS RELEASE

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Ames 62-41

FOR IMMEDIATE RELEASE November 29, 1962

SPACE SCIENCES DIVISION FORMED AT AMES RESEARCH CENTER

A Space Sciences Division has been formed at the National Aeronautics and Space Administration's Ames Research Center, Moffett Field, California, it was announced today by Dr. Smith J. DeFrance, Director of the Center.

The mission of the new division is to conduct research for the nation's space program in the areas of geophysics, interplanetary and planetary physics, planetary sciences, astronomy, and astro-physics.

Heading the division is Dr. Charles P. Sonett, 38, who came to the Ames Research Center from NASA Headquarters in Washington, D. C., where he served as Chief of Sciences for Lunar and Planetary Programs.

Four branches have been established in the Space Sciences Division:

1. Electrodynamics Branch - It will study problems in cosmic electricity, electrical currents, magnetic fields, flow of ionized gas in space, geo-magnetic storms, aurora, solar flares, and solar winds.

2. Planetary Sciences Branch - It will study the composition and physical parameters of planetary atmospheres by means of ultra-violet and infra red spectroscopy. It will also conduct a laboratory program to identify molecular gases in planetary atmospheres.

3. Theoretical Studies Branch - It will conduct theoretical invest-

- MORE -

igations in areas associated with the space science experimental programs.

4. Engineering Branch - It will be responsible for the development of instrumentation for space experiments, and the engineering and coordination of experiments on spacecraft.

Dr. Sonett, while at NASA Headquarters, was a member of the Space Sciences Steering Committee, and was chairman of three of its sub-committees: Lunar Sciences, Planetary and Interplanetary Sciences, and the working group on Apollo lunar landing scientific experiments.

Prior to joining NASA, Dr. Sonett was one of the pioneers of the Ramo Wooldridge Corporation in Los Angeles, later transferring to its subsidiary, Space Technology Laboratories, Inc., where he was in charge of the Space Physics Section. During this period he served as a lecturer in electronics at UCLA.

Dr. Sonett received his Ph.D. degree in Nuclear Physics and his M.A. degree from UCLA, and obtained his A.B. degree from the University of California at Berkeley.

He resides with his wife, Virginia, and two children, Eric and Maria, at 877 Moana Court, Palo Alto, California.

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Ames 62-41

NEWS RELEASE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Ames 62-42

FOR RELEASE FRIDAY PM's,
DECEMBER 7, 1962

LUNAR LANDING SIMULATOR BEING FLOWN AT AMES RESEARCH CENTER

A lunar landing flying simulator to conduct research for the nation's manned exploration of the moon and planets is now performing flight missions at NASA's Ames Research Center, Moffett Field, California.

Adapted from the jet-powered Bell X-14A vertical takeoff and landing aircraft (VTOL), the simulator is the only flying vehicle in the country capable of approximating lunar landing power and spacecraft control conditions.

"This is an excellent example of how we are often able to benefit space research programs from aeronautical research," stated Dr. Smith J. DeFrance, Director of the Ames Research Center. "The power and control concept employed in the X-14A was originally being researched for its application to vertical takeoff aircraft, but when we investigated the potential of the X-14A as a lunar landing simulator and came up with good results, we realized that we were getting a valuable bonus effect."

The lack of atmosphere at the lunar surface precludes the use of wing and tail section control surfaces. Although the X-14A has such control surfaces for conventional flight, it is also equipped with jet reaction nozzles for the control of roll, pitch, and yaw (see the enclosed diagram). The same type of control system is used on the Mercury capsules during their earth orbital

- MORE -

flights, and on the X-15 rocket planes for control at their higher operating altitudes. Energy for the jet reaction nozzles is bled from the X-14A's jet engines.

Vertical descent and ascent by the simulator is accomplished by diverting the jet exhaust created by the X-14A's twin jet engines downward (see the enclosed diagram). Controllable cascade vanes in the exhaust pipe divert the exhaust gases.

In an actual lunar landing, the rocket engine of a spacecraft would be supplied with its own oxygen source, whereas the X-14A obtains its oxygen for fuel combustion from the earth's atmosphere. In either case, the power principle is the same.

The center of gravity of the aircraft is located over the exhaust section, thereby giving vertical lift without additional control movements.

The importance of lunar landing simulation research was emphasized by Fred J. Drinkwater, III, research pilot for the investigations, when he said, "One of the most critical first landings ever to be made in the history of man will be that made on the moon, and in a very strange environment. All available methods of research should be utilized.

"A great similarity exists between the flight control system of our simulator and that proposed for a lunar craft," he added, "and this makes the X-14A a logical vehicle to investigate problem areas connected with the let-down and landing phases of the lunar mission."

The acceptability of the X-14A, from the pilot's viewpoint, as a research tool and as a possible trainer for spacecraft pilots has been verified by those who have flown the aircraft. It has been exceedingly well received and is considered "to fly well." Mr. Drinkwater remarked, "It's a friendly aircraft, the

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friendliest of all VTOL aircraft. It behaves itself and there are no mysteries about it."

The purpose of the lunar landing simulation program being conducted at the Ames Research Center is to investigate 1) various flight trajectories, or paths, from a point in space one mile horizontally and 1,000 feet vertically from the landing point; 2) desirable types of control power; 3) rotary damping, or the reduction of the tendency of an aircraft to oscillate when subjected to a control motion; 4) fuel consumption during the landing trajectory; 5) pilot effort required; 6) pilot opinion; and 7) the physiological and psychological effects, such as pilot anxiety levels experienced in simulated lunar landings.

The X-14A is also uniquely qualified as a simulator in that it can duplicate desired flying characteristics programmed into its electronic computer. Based on such inputs, computer signals then actuate electric servo-motors which in turn operate the jet reaction control nozzles.

Not only does the X-14A have adequate characteristics to simulate a lunar landing mission--because the craft's characteristics can be varied--but it has the capability of investigating some of the emergency conditions that might confront an actual lunar landing vehicle. Lunar approach, descent, landings on surfaces of various compositions, takeoff, ascent, and docking are some of the flight maneuvers within the simulation potential of the X-14A. Realistic simulation of lift and spacecraft control has been demonstrated.

An advantage of the X-14A lunar landing simulator over ground-based, or fixed, simulators is that the X-14A is capable of all-axis motions while in flight. Pilot physiological and psychological reaction studies in a flying simulator are more realistic.

Further evidence of the value being accrued from the X-14A is the fact that

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results of VTOL research by scientists and engineers of the Ames Research Center have been applied by the British in the development of their operational Hawker P.1127 VTOL strike fighter. Mr. Drinkwater flew the Hawker in England this past summer.

According to L. Stewart Rolls, project engineer for the X-14A, "A prime factor in evaluating various lunar landing trajectories, of which we are flying five, is the amount of fuel necessary to complete the maneuver. On a lunar craft, it is necessary to consider fuel used for control through the jet reaction nozzles, and for the main lift-producing engines.

"For comparison purposes between the X-14A and a lunar craft, we feel that our research has given us approximate measures of the fuel needed. The time required to complete the simulator let-down and landing would be a measure of the amount of fuel needed for the main lift-producing engine, and the standard deviation of the control motions would indicate the amount of fuel required for control purposes.

"Of the five trajectories, varying from a straight-line approach to one involving a final 800-foot vertical descent, the pilot can perform all without difficulty. The straight-line approach appeared to be best from a pilot's point-of-view, but is not the most economic from a fuel standpoint," Mr. Rolls concluded.

Whereas a pilot can perform a let-down easily with only outside visual and motion inputs, he can perform his task more efficiently if his field of view includes both the prescribed touchdown point and the horizon. On a vertical trajectory in which he does not have a view of the touchdown point, the pilot can descend satisfactorily, but with a less precise trajectory, by observing the changing angle of his line of sight to the horizon and by continuous reference to ground objects that are within his field of view.

Research results stemming from the X-14A lunar landing simulator have given cause for further consideration in the following areas:

1. Pilot's ability to perform lunar landings with other types of pilot control handles, such as the side-arm type, as compared with the conventional aircraft control stick and rudder pedals.

2. Investigation of the feasibility of other types of flight trajectories.

3. Effectiveness of on-off pulse-type control as against proportional-type control.

4. Use of step throttles for lift-producing engines.

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Ames 62-42

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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Ames 63-7

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FOR RELEASE: February 26, 1963, AM's

NEW SPACECRAFT CONCEPT SUCCESSFULLY TESTED

A wingless, maneuverable spacecraft capable of orbiting the earth and landing like an airplane is ready for full-scale flight research as a result of extensive wind tunnel testing and analysis by a team of scientists at the NASA's Ames Research Center in California.

Known as the M-2 "lifting body," the spacecraft represents a complete departure from conventional aircraft and current spacecraft. Ames scientists say the craft could give an astronaut over 1,000 miles of lateral maneuverability after entering the earth's atmosphere from space flight, and allow him to land horizontally at almost any suitable area within the United States.

Consisting of a somewhat slender half-cone body with a blunted nose, this M-2 version of the lifting body concept has a boattailed rear portion. It has no wings. Elevons, landing gear, vertical fins, and a canopy (or "cockpit greenhouse") are its only identifiable features.

Such spacecraft are highly maneuverable, have a high amount of useful payload volume, and are re-useable after their horizontal landing. The lifting body concept is viewed as a major step forward in the evolution of operationally flexible and efficient space vehicles.

"This configuration and other lifting body shapes have been studied and tested at Ames Research Center for more than three years," said research scientist George Edwards, who supervised the low speed testing of the vehicle. "Our extensive results show that a wingless lifting entry body, properly

- MORE -

configured and equipped with controls, can have a horizontal landing capability equal to or better than the X-15 hypersonic research aircraft. This means that an astronaut could accurately choose his landing point following a space mission, and land horizontally."

"And our results indicate that deceleration stress on the astronaut during atmosphere entry would be reduced from about eight times the force of gravity to less than two times the force of gravity," added Clarence Syvertson, who coordinated the hypersonic test series at Ames.

"A full-scale vehicle is now under construction for manned piloted low speed and landing flight research," according to Ames scientist George Kenyon, who carried out the low speed wind tunnel testing. "It will have an enlarged canopy and a dorsal fin for safety purposes. The first piloted tests will take place at NASA's Flight Research Center, Edwards, California, in the early spring."

According to Dr. Alfred J. Eggers, Jr., Assistant Director for Research and Development Analysis and Planning at Ames Research Center, and originator of the idea of lifting bodies in 1957, "the M-2 configuration is one of the first steps in demonstrating a concept. We are now carrying our research further, here at Ames and elsewhere, in the hopes of advancing the lifting body concept to its fullest possible extent."

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Ames 63-9

FOR RELEASE:
Saturday AM's, March 2, 1963

The National Aeronautics and Space Administration has asked industry to study the feasibility of using a series of earth satellites to conduct biological experiments upon plants and animals under an extended weightless environment.

The Ames Research Center, NASA, has asked for proposals on from two to four study contracts of six weeks' duration. These are to obtain preliminary design of space vehicle systems that would be suitable in the event a flight program is authorized.

Phase 1, the only phase now approved, envisions a study of a series of six biosatellites, to be launched during a period of 18 months, with flight durations of from three to 30 days. A decision on the flight program will be made following an evaluation of the Phase 1 studies.

Requests for Phase 1 proposals are being sent to industry by the Ames Research Center and bids are expected to be submitted to Ames in about three weeks.

Each of the payloads of such biosatellites would be recovered and returned to the experimenters for post-flight study. NASA has received about 60 suggestions of experiments that might be performed, and these are being evaluated.

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Under the study contracts, all aspects of the project are to be considered, but primary emphasis will be placed on the spacecraft. Other special aspects include environmental control and life support systems, spacecraft stabilization, re-entry nose cone, and sensing, recording and telemetry systems.

Such a biosatellite project would be suited to studying biological responses to periods of weightlessness more prolonged than those obtainable by rocket flights or other short-duration tests.

The biosatellite project would fill a longstanding need of the scientific community for a recoverable earth-orbiting biological laboratory.

Typical experiments would be expected to have such objectives as determining:

1. The reactions of animals to prolonged periods of weightlessness.
2. The effects of weightlessness or removal from the earth's rotation on the biological rhythms and cellular processes of plants and animals.
3. Whether the condition of weightlessness has an effect on the susceptibility of plant and animal specimens to radiation damage.

- END -

Ames 63-9

NEWS RELEASE
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FOR IMMEDIATE RELEASE

X
Xl Probes (General)

April 26, 1963

The Ames Research Center of the National Aeronautics and Space Administration today selected three companies for negotiation of contracts to study a Solar Probe project which would greatly extend man's knowledge of the sun.

General Electric Company's Missile and Space Division, Philadelphia, Pennsylvania, Martin-Marietta of Baltimore, Maryland, and the Philco Corporation of Palo Alto, California were selected from sixteen companies submitting proposals.

Each contract will call for a four-months study to provide information in depth for the procurement of any future Solar Probe spacecraft, should the program become fully authorized. It is currently funded only to support these study contracts, each of which is expected to be valued at about $135,000.

Since the sun is the major source of energy in the solar system and since life is dependent upon this energy, scientists at Ames Research Center believe that a better understanding of the sun's processes and their effects on the earth is needed. They feel that such understanding can be attained

- MORE -

from the Solar Probe missions which will be studied under these contracts.

Specific information regarding solar fields, particles, radiation, and other solar phenomena between the earth and the sun could be obtained by a Solar Probe. The probe would reach a distance of three-tenths of an astronomical unit, or about 28 million miles from the sun. Such information could improve weather prediction and control and aid communications on earth. A better understanding of the radiation hazard to manned space flight associated with solar flares should also be obtained with a Solar Probe.

Howard F. Matthews of 1998 Coleen Drive, Los Altos is the leader of the Solar Probe Study Group at the Ames Research Center.

In addition to the preliminary design of a spacecraft and its subsystems, the study contracts include determination of scientific objectives and experiments, mission analysis, ground support equipment, reliability estimates, flight operations, design requirements, a development plan, a cost funding schedule, and advanced research and development items.

Not to be confused with Project Pioneer, also managed by the Ames Research Center, and concerned with gathering information on certain solar phenomena at about 93 million miles from the sun, the Solar Probe will come much closer to the sun than Pioneer spacecraft. Proximity to the sun is not the important consideration in the Pioneer studies.

- END -

NEWS RELEASE

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Ames 63-20

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FOR RELEASE: 2:00 PM, EDT, May 1, 1963
(11:00 AM, PDT)

April 30, 1963

The NASA Ames Research Center, Moffett Field, California, announced today that a contract of $1,374,818 for fabrication of a hypervelocity test device for the investigation of flight in planetary atmospheres has been awarded to the Thiokol Chemical Corporation, Brigham City, Utah.

Slated to be part of the Hypervelocity Free-Flight Facility now under construction, the wind tunnel structure, combined with a light gas gun, will help attain rational designs for manned satellites, vehicles returning from the moon and other planets, and possibly space vehicles for entering the atmosphere of other planets.

The contract calls for the design, fabrication, testing, and delivery of a complete tunnel structure. Fabrication will be performed at Thiokol's plant in Pocatello, Idaho. Completion of the facility is anticipated within one year.

The facility is expected to reach test velocities of 50,000 feet per second, or over 34,000 miles per hour. It will be the fastest known test chamber involving an aerodynamic test model in an airstream flow. Such high velocities are achieved by launching the test model in one direction through a gas medium moving in the opposite direction. This is a concept of aerodynamic research

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developed at Ames twelve years ago under the direction of Ames Assistant Director for Astronautics, H. Julian Allen.

Flights of small-scale research models or models of space vehicles will take place in a test section that will be instrumented to provide information on gaseous radiant heating, ionization and consequent interference with radio transmission to and from the vehicle, overall forces, moments on the model, and other related problems associated with extreme flight speeds.

Several guns for launching the models will range in size up to 37 millimeters. Three test section nozzles will generate airspeeds from 6,000 to 15,000 feet per second.

Such a test facility is needed to investigate vehicle recovery on earth after orbiting the moon or nearby planets such as Venus and Mars, or the landing of space vehicles on these planets. Solutions to a number of technical problems, some of which are presently not well understood, have been needed for some time.

In the area of aerodynamics, the problems of atmosphere entry at speeds from those of near-earth satellites to those in excess of earth's escape speed are severe. The general problem is one of arriving at a configuration or shape that will withstand the radiant and convective aerodynamic heating, be statically and dynamically stable and controllable, and have the most advantageous values of lift and drag for the selected mission and flight trajectory. The solution of many problems in these categories depends upon laboratory research, not only in air at speeds up to 50,000 feet per second, but also in gases representative of the atmospheres of other planets.

Hypervelocity free-flight facilities can correctly duplicate the effects of the breaking up of a chemical combination into simple components (or dissociation), ionization, and recombination on heat transfer rates and flow fields. They also permit the observation of model motions and the ionized flow field under actual flight conditions. Such information, used in conjunction with more detailed measurements from other ground facilities, will permit understanding and thus prediction of the behavior of actual space vehicles in flight.

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Ames 63-20

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Ames 63-26

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FOR RELEASE: JULY 2, 1963
1:00 PM, PDT

X Ames Research Center

July 2, 1963

GENISCO TO BUILD NASA FLIGHT MOTION SIMULATOR

Genisco Inc., a small business concern located in Los Angeles, California, has been selected by the National Aeronautics and Space Administration for negotiation of a development, fabrication, and assembly contract for a man-carrying motion generator for research into guidance and psycho-physiological problems of space flight.

The contract will be negotiated on a fixed price basis. The Genisco proposal offered the lowest price. It is currently estimated that the contract will be approximately $6 million.

The motion generator is the major component of an advanced space navigation simulator to be located at the NASA Ames Research Center, Moffett Field, California. Ames is a leading NASA Center for advanced research into problems related to life sciences and man's capability to operate in space.

The new simulator, to be known as the space guidance research facility, is expected to be in operation in about two years

In addition to the motion generator, the new facility consists of three major components: a computer for establishing motions and maneuvers throughout

- more -

a full range of operations in space flight; a support and drive mechanism for the simulator; and a large structure to house the facility.

Space navigation and guidance research, and physiological studies in support of advanced manned space flight are under the electronics systems and bio-technology programs of NASA's Office of Advanced Research and Technology.

The new facility will be capable of simulating every known factor of control and navigation of space flight, except weightlessness. With it, scientists will be able to run realistic flights from earth take-off through orbital flight, mid-course change, landing on the moon or other planets and returning to earth. The equipment will include two simulated spacecraft or capsules, to provide flexibility in payload and performance. One capsule will be built for a crew of three on simulated missions, the other for one man in advanced physiological research.

Under terms of the contract, the generator will consist of a centrifuge on a 50-foot boom, a vertical drive, a programmed braking device, fluid bearings, the capsules and controls, and drives and structures for motions about three axes of flight.

A design study contract for the project previously was issued to the General Electric Company. The design and information produced by G. E. under that contract was made available to all interested bidders for the present development contract.

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On March 22, a total of 26 companies were solicited for proposals on the motion generator and five responded, including G. E., Westinghouse, AMF, Genisco, and Rucker Company.

The simulator will be housed in a 130-foot diameter circular room with special foundations. Medical, shop and control areas will be located in spaces adjoining the room. The capsules will contain full crew life support systems for flights of very long duration. They will be provided with navigation, guidance power, and control apparatus, environmental controls and instrumentation necessary to the navigation problems presented.

Ames has let a contract for architect and engineering services for the main building to the firm of Skidmore, Owings and Merrill of San Francisco. Other major parts of the space flight guidance research facility will be contracted for within the 1964 Fiscal Year. Total cost of the facility is estimated at $9 million.

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Ames 63-26

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Ames 63-29

FOR IMMEDIATE RELEASE

July 11, 1963

ASTRONAUTS ARE CONDUCTING RESEARCH TEST AT AMES

Seven of the nation's astronauts are currently conducting simulated manned spacecraft missions at NASA's Ames Research Center, near Mountain View, California.

Astronauts Gordon Cooper, Walter Schirra, Donald "Deke" Slayton, Frank Borman, Elliot See, Thomas Stafford, and John Young have been subjected to space flight stresses on the Ames motion simulator, or centrifuge, since Wednesday.

The Ames tests required that the astronauts be spun around on the simulator at several times the force of gravity. During their flight, special stresses were superimposed on them to simulate the environment they may encounter during future manned space missions.

Astronaut "Deke" Slayton, spokesman for the group, said "Ultimate fidelity in simulating various phases of a manned space mission has been an engineering goal of the program since its inception. We are using the centirfuge at Ames because it is the only one in the country capable of superimposing the stresses we are interested in. The engineers and technicians at Ames have done a credible job

- more -

in conquering the difficult simulation problems involved in these tests."

Simulation is needed in the nation's space program to test equipment performance and to achieve the maximum effectiveness from the combination of man and machine. By simulating the conditions of space flight, scientists are able to maintain carefully controlled conditions with great safety and economy while investigating problems in the research phase of a program and for later astronaut training.

In accordance with NASA's philosophy of investigating every conceivable aspect of space flight, the tests at Ames are designed to determine the astronauts' ability to read vital instruments under conditions which may occur during the mission. The astronauts' ability to react and take proper action while under stress was exercised during the tests.

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Ames 63-29

NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA

Ames 63-42

TELEPHONES:
Weekdays 8:00 AM - 4:30 PM
968-9411, Code 415

Other Hours
241-5578, Code 408
323-5463, Code 415

FOR IMMEDIATE RELEASE

Monday, October 28, 1963

AMES TO HOST SCIENCE STUDENTS

Twenty-five high school students from the Northwestern states, including Alaska, are presenting scientific papers at NASA's Ames Research Center, near Mountain View, today and tomorrow in competition for a trip to Washington, D. C., and the final judging of the National Science Youth Congress.

In addition to their formal sessions, the students will tour the National Aeronautics and Space Administration facility and confer individually with scientists working in their project field.

Dr. Matt Vessel, Chairman of the Biology Department at San Jose State College will speak to the students at dinner Monday evening.

Benjamin H. Beam, Chief of the Measurements Research Branch at Ames, will present certificates to the three winners and three alternates following dinner Tuesday evening.

- more -

The student papers will be judged by high school teachers from the Bay Area and Ames scientists.

The National Science Youth Congress, sponsored jointly by NASA and the National Science Teachers Association, is yet another effort to encourage promising students to enter science as a career. Through such programs, participating students and others are encouraged to continue to develop their talents and interests in science through scientific investigation.

For the first time, these students will be brought into a close association with scientists working on the frontiers of space-age knowledge and be given an opportunity to tour a scientific research facility.

Recognizing that an idea or experiment not presented to others is futile, the sponsors of the National Science Youth Congress are particularly concerned with developing the ability of these potential scientists to communicate their results to the scientific community. For some of the students, the Ames program will provide the first opportunity to deliver verbally a technical paper resulting from a project.

Participating students, their hometowns, and paper titles are:

Steven Cerri, Stockton, California: "A Liquid Propellant Rocket Engine."

James Davis, San Francisco, California: "The Effect of Nonutilization of the Digestive System on the Rat."

- more -

Richard J. Weiss, Everett, Washington: "Environmental Ecology of Pond Animals."

James K. Hahner, Walla Walla, Washington: "A Study in Aerodynamics."

Kit Elizabeth Staley, Anchorage, Alaska: "Investigation of Dietary Supplements in the Prevention of Radiation Sickness in Rats."

Virginia Ann Freeman, Grapeview, Washington: "Vacuum Pump Development."

Donald Bollinger, Caldwell, Idaho: "Determination of Digestibility of Marine Algal Protein."

Eric Sweetman, Beaverton, Oregon: "The Development of Pure Fluid Analogues to Electrical Circuits."

Harry Leavitt, Mercer Island, Washington: "Bone Regeneration in Compound and Simple Fractures."

Jerrie Wirkus, Idaho Falls, Idaho: "Biological Clocks."

Clifton D. McIntosh, Pocatello, Idaho: "The Polarograph."

James R. Otto, Jr., Everett, Washington: "Residue Theorem Extended to Summation."

Helen M. Laurvick, Butte, Montana: "The Effects of Radiation on Dormant Barley Seeds."

Leslie K. Poppe, Pocatello, Idaho: "Algae: The Culture, Analysis, and Uses of Spirogyra."

- more -

Ann Coppock, Portland, Oregon: "Diceratherium Armatum Discovered in New Oregon Locality."

Edward H. Cohen, Seattle, Washington: "An Experiment in Grafting Planarian Body Parts."

Craig Pearson, Upton, Wyoming: "Electronic Fish Sound Detection."

Judy Krall, Kemmerer, Wyoming: "Tissue Cultures in 'Vitro.'"

John A. Newkirk, Berkeley, California: "What Affects the Carbon Dioxide Production of a Yeast and Sugar Mixture?"

Mary F. Moffitt, Albany, California: "The Effect of Heat on Pigment Production in Micrococcus Roseus."

Brent Carter, Byron, Wyoming: "New Type Algae for Space Travel."

James W. Goff, Glendive, Montana: "A Biochemical and Geochemical Analysis of Selected Fossiliferous Residues."

Steven H. Schroeder, Caldwell, Idaho: "Spectrum--Key to the Universe."

Candace Etter, Berkeley, California: "Milk Bacteria and I-131."

Joseph W. Parmelee, Walla Walla, Washington: "Analytic and Experimental Design Procedures for a Novel High Speed Parallel Adder."

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Judges are:

Ira D. Guthrie, Biology Department, Venicia High School;

George Castellani, Biology Department; Campolindo High School;

Cathleen Rodman, Biology Department, Palo Alto High School;

Ethel Kilgore, Professor of Biology, San Francisco State College;

Eugene Roberts, Science Department Head, Polytechnic High School, San Francisco, California;

Dr. Jacob Shapiro, Cellular Biology Branch, Ames Research Center;

Dr. Larry Hochstein, Biochemical Evolution Branch, Ames Research Center;

and Alan E. Faye, Jr., Technical Assistant to the Assistant Director for Aeronautics and Flight Mechanics, Ames Research Center.

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Ames 63-42

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December 23, 1964

Ames 64-31

FOR IMMEDIATE RELEASE

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A space chamber in the form of a ten-story, 30-million-pound, hollow concrete monolith will be the main feature of a new test lab at NASA's Ames Research Center, Moffett Field, California.

The reinforced-concrete vacuum chamber and Structural Dynamics Laboratory will be complete next fall under a $992,000 contract let at the weekend to the Carl N. Swenson Company of San Jose, California.

The radical design approach will produce a 100-foot pentagonal tower with walls three feet thick. When complete, the chamber may be the only one of its kind, its designers say.

Its interior volume will be equivalent to a 100-foot cylinder, 35 feet in diameter. The entire inside will be free space without interior

-more-

structural members.

The chamber will accommodate full-scale segments, or smaller scale models, of rockets and spacecraft. It can be evacuated to a pressure of ten millimeters of mercury. This is equivalent to 19 miles above the earth, or above 99 percent of the earth's atmosphere.

This degree of vacuum is sufficient for testing of spacecraft structures because at this point, the damping (reduction) of vibration in a structure by air molecules becomes unimportant.

The new Structural Dynamics Laboratory will conduct structural testing of most types required by the Ames Center. It will have some 25,000 square feet of space on two floors, 19,000 feet in test areas; electrical, mechanical, and other shops; the rest in office and service areas.

The vacuum chamber tower will have walls a minimum of two and a half feet thick, three feet thick for the lower 30 feet, to withstand atmospheric pressures of more than a ton per square foot.

The chamber will have various advantages for structural testing. The building itself will serve as part of the testing equipment. It will form a huge seismic mass to blot out all external vibrations. It will also have good acoustics for testing because of the non-parallel walls resulting from its pentagonal shape.

Provision has been made for 15 million watts of electric power

-more-

for infrared lamps to simulate the intense heats of atmosphere reentry. The chamber will have a work platform able to reach any point in its interior.

A total of more than a million pounds of force can be brought to bear within the chamber through four hydraulic actuators. These will produce high frequency vibration stresses, and other effects on spacecraft structures under test.

To maintain the vacuum, cast-in-place construction will be used with precise placement of reinforcing steel and precision mixing of concrete ingredients to minimize cracking, shrinkage and porosity. Two and a quarter inch steel reinforcing bars will be located four inches apart to add strength. The great weight of the structure is counted on to help seal necessary joints and openings.

The chamber will be evacuated by pumps already existing in the nearby Ames Gas Dynamics facility. A side-rolling door 25 by 26 feet will be sealed by a pressurized flexible ring.

The new test laboratory will also have a second seismic facility to completely isolate structures test equipment from exterior vibrations. This will be a 15-foot reinforced concrete cube, weighing half a million pounds, and hollowed to accommodate shakers and other devices.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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January 28, 1965

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FOR RELEASE: SATURDAY AM's
January 30, 1965

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Ames 65-3

Existence of a "tornado-like" airflow along the leading edge of a special airplane wing shape is giving promise to the creation of good slow speed characteristics of a wing that has been primarily designed for high-speed efficiency.

Called "vortex airflow", the phenomenon has been visually observed and studied by aeronautical engineers at NASA's Ames Research

- more -

Center, Moffett Field, California, on a supersonic jet airplane with a redesigned wing.

The desire to minimize the landing speeds for the proposed supersonic transport has led aeronautical engineers and designers to consider the advantageous effects of the leading-edge vortex flow. Full-scale data on this type of vortex flow are being obtained by Ames engineers in the flight studies.

The vortices classically associated with wings are horizontal whirlpools or "tornadoes" of air that are always present when a wing develops lift. These normally trail back away from the airplane from a point near each wing tip. They result from the difference in pressure between the wing upper and lower surfaces. When a sharp leading edge is used, however, together with certain planforms (shapes), additional vortices result which extend along the leading edge in a spanwise direction. These leading-edge vortices improve the lift of the wing much as do landing flaps and can actually replace high-lift devices such as flaps and slats and thereby simplify the wing design with less penalty in high-speed performance.

The vortex airflows on airplane wings that trail back from the wing tip have been studied both theoretically and experimentally for many

- more

years, and are well understood. The mechanism of the leading-edge vortex flow, which results from a continuous separation of airflow along the sharp leading edge, is not as well known.

A Douglas F5D fighter-size aircraft is being used for the flight research phase of the study. The wing of the supersonic plane has been re-worked by Ames craftsmen to simulate a wing that might be feasible for future supersonic commercial air transports.

The re-worked wing is called an "Ogee planform" wing, the term "Ogee" being an architectural term for an S-curve shape and w hich is characteristic of the leading edge of the F5D wing when viewed from above. This shape possesses a high leading-edge sweepback angle close to the fuselage, which is important in generating the leading-edge vortex.

Following re-design of the wing, the F5D was first tested in Ames' large-scale 40- by 80-foot wind tunnel, the world's largest, to obtain full-scale aerodynamic data on the planform wing and to assure the plane's capability for actual flight.

Additional studies of a theoretical nature are currently being made under a NASA contract with Vidya Division, Palo Alto, California, a division of Itek Corporation.

- more -

A unique aspect of the flight research study is the use of the existing fighter-size aircraft with its re-designed wing to simulate transport aircraft flight conditions. By modifying the existing aircraft, costs are considerably reduced from those that would be required if an aircraft was specifically built for such a research effort.

The vortex airflow research studies are part of a research program sponsored by the Office of Advanced Research and Technology in NASA Headquarters, Washington, D. C.

- end -

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Ames 65-11
March 19, 1965

Three talented high school students with their research projects have taken the honors at the regional Youth Science Congress, which ended today at NASA's Ames Research Center.

The event, sponsored by the National Science Teachers Association and the National Aeronautics and Space Administration, was

- more -

hosted by the Ames Research Center. The Congress covers the seven Northwestern states of Washington, Oregon, Northern California, Alaska, Idaho, Montana, and Wyoming.

Seventeen students from Washington, Oregon, Northern C lifornia, Montana, and Wyoming had been selected earlier by judges from their respective states to present papers at the Congress.

Strong interest in science at specific high schools is shown by the fact that nine of the papers chosen for consideration came from only three schools. Three of the best science projects came from the small high school in Choteau, Montana, a community of 2,000 persons.

The three winning students now will be eligible to attend the National Youth Science Congress in Washington, D. C. this June to compete with students from seven other regional Congresses.

The three best papers and their authors were:

- more -

"KWR Theory of Light Interaction," an experiment on the interaction of a laser light beam with itself, given by Kenneth Ritthaler of Upton, Wyoming. Mr. Ritthaler attends Upton High School, and his science teacher is B. Gene Bauer.

Miss Gayle Richardson of Berkeley, California, won a top position with a paper entitled "Malathion Menu for Microbes." Miss Richardson goes to Presentation High School, and is taught science by Sister Mary David, PBVM. Her paper was a study of microbe metabolism.

The third top paper was "Condensation Nuclei," a cloud seeding study by Janet Wood of Choteau, Montana. Miss Wood attended Choteau High School. Her teacher is Albert C. Finley. He also teaches the other two students from Choteau, whose papers were accepted for the Congress.

Alternate best papers chosen were those of: Gregory J. Raugi of Atherton, California. His paper, "Tumor Resistance in Mice," was a cancer study. He attends Menlo-Atherton High School, and his science teacher is Harry K. Wong.

The other alternate was Michael J. Fowlis, Portland, Oregon. Mr. Flowlis' paper was "An Experiment in Model Building," an analysis of chemical bonding in molecular structures. He attends Sunset High School in Portland, and his teacher is Harold Wik.

- more -

Judges for the Congress were William Bunton, chemistry teacher, Palo Alto High School, Palo Alto, California; Frank Smith, head, science department, Los Altos High School, Los Altos, California; Dr. Richard E. Grindeland, Biochemical Endocrinology Branch at the Ames Center and Dr. Leonard P. Zill, Biological Adaptation Branch, Ames Research Center.

The program included a welcome by Dr. Smith J. DeFrance, Director of the Ames Research Center, and tours of Ames laboratories, wind tunnels, and life science facilities.

Students read their papers personally to sessions of the Congress, visited Chinatown in San Francisco, and participated in group discussions with Ames scientists.

By states, high school student papers accepted for presentation at the Congress were as follows: Washington, four; Montana, four; Northern California, seven; Oregon, one; and Wyoming, one.

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Ames 65-11

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Ames 65-12
April 20, 1965

NASA LETS CONTRACT FOR SUPERSONIC TRANSPORT FLIGHT SIMULATOR

NASA pilots will be able to "fly" the supersonic transport before it is built using a new advanced flight simulator.

The space agency's Ames Research Center near Mountain View, California, has let a $1,382,000 contract for fabrication of what appears to be the most capable and versatile flight simulator yet undertaken.

- more -

The contract went to the American Machine & Foundry Company of York, Pennsylvania, and covered motion-generating equipment, and other machinery for the flight simulation device. Structure to house the big machine and its data handling equipment are not included in the contract. Design was done by the Ames Research Center and estimated completion date is mid-next year.

The new device will be able to simulate nearly all flight situations for aircraft (and, in future applications, for spacecraft) except cases involving high acceleration forces on the pilot, or aerobatics. However, its immediate task will be to simulate transport aircraft operation with emphasis on the U. S. supersonic transport.

The large-scale new simulation system will simulate flight basically by producing the motions a pilot would feel in flight, and by projecting a picture of the changing landscape on a screen in front of him. The system will be known as the Flight Simulator for Advanced Aircraft.

A replica of a typical transport aircraft cabin with operating instrument panels and stations for three-man crew will be a principal feature.

- more -

The simulator will provide "all meaningful inputs to the human senses experienced in manned control of advanced aircraft during all phases of operation," said John Dusterberry, Chief of the Analog and Flight Simulator Branch at the Ames Research Center.

"This means," he added, "that we will be able to duplicate most aspects of a supersonic transport flight, say from San Francisco to Chicago. We should be able to get enough realism that the 'crew' will feel it has actually made the flight. In the future, using the same basic equipment, we may well provide close simulation of manned recoverable booster flight, and of moon and planet landings and takeoffs."

The simulator was designed by the Research Facilities and Equipment Division at Ames. It will have "six degrees of freedom," which means it will move in all possible axes of motion: fore and aft, vertical, and side-to-side; plus pitch, roll, and yaw.

While various other six-degrees-of-freedom motion simulators exist, the new machine will be by far the largest ever built, it is believed.

It will be unique in having 100 feet of lateral motion. This is needed to simulate supersonic transport (SST) flight because the SST

- more -

crew will be far forward of the center of rotation of the aircraft. Hence yawing movements will be very large.

Broad side-to-side motion is also needed to provide the feeling of changes in direction, says Shizuo Doiguchi, project manager.

"Most downward and upward movements can be satisfactorily simulated by tilting the cabin up or down a few degrees. However, the large amount of sidewise motion available in the new machine will allow more realistic simulation of changes in direction than was possible formerly," he explained.

Much of the simulation for the new device as for previous simulators, will be handled by a small television camera.

The camera "flies" over a model of the airport or countryside being traveled over. What it "sees" is projected on a screen in front of the simulator cockpit windows. These visual systems are effective enough to make the pilot feel he is "flying" above the simulated landscape as the television camera moves over it.

Why build big, expensive simulators? "Because it's cheaper than building far more expensive prototype aircraft," says Maurice White, Assistant Chief of the Flight and Systems Simulation Branch at Ames. Mr. White developed performance specifications for the big simulator.

- more -

"Much can be learned about man's ability to handle new aircraft at far less cost and with complete safety on the ground, through simulators," he said.

This is particularly true of the U. S. SST now in design stages, because, unlike other recent transports, it has not had a preceding military prototype.

The new simulator will contribute SST design data, such as how to divide up among crew members the work of running the aircraft. The simulator will help researchers learn how much inherent aerodynamic stability the plane must have to be flown by human pilots. Its results can suggest the best kind of control system and requirements for most efficient operation of hydraulic and electric systems.

To produce a landing, takeoff, or other maneuver for design test, the simulator will work as follows:

The research pilot will be assigned a general flight task. This will be converted to a specific flight path by his control actions. These actions in turn will be converted to simulator movements in the various axes of motion--and also to operations of visual and aural cue-producing devices. This will be done by a computer program which reproduces the characteristics of the aircraft being simulated.

- more -

The pilot will see, feel, and hear the consequences of each control action, and, therefore, will respond to his own actions.

In general, motions will be produced by electric motors driving either chain or drive screw systems.

Limits of motion for the simulator will be plus or minus 45 degrees in roll, plus or minus 22-1/2 degrees in pitch, plus or minus 30 degrees in yaw, ten feet up and down, eight feet forward and back, and 100 feet side to side.

Rapid accelerations in the various axes of motion will be obtained with high-response electrical servo drives.

The simulator will be housed in a building covering a site 43 by 190 feet.

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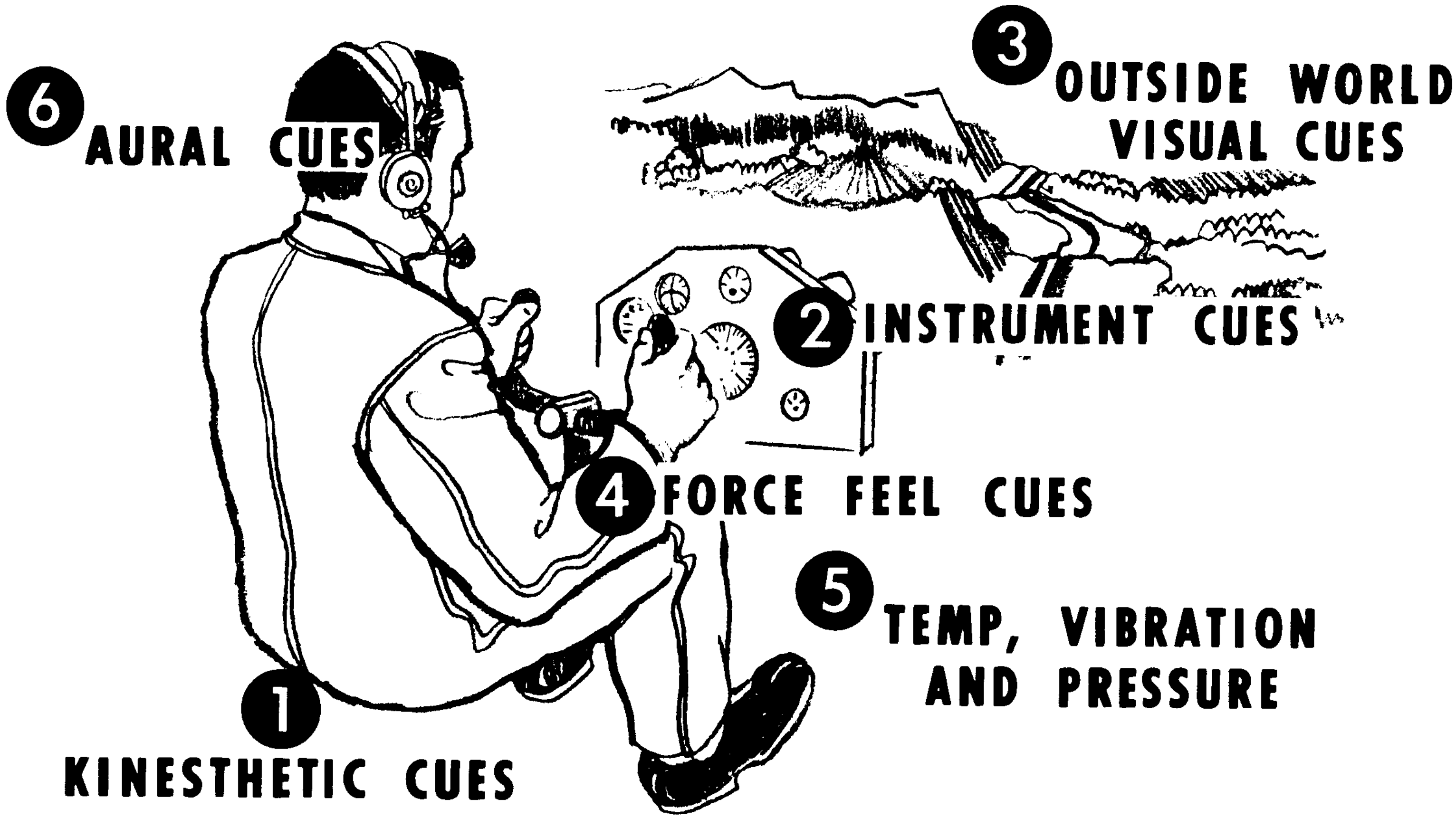
SIMULATOR REQUIREMENTS



FOR MAXIMUM REALISM IN SIMULATING FLIGHT, THE "PILOT'S" NERVOUS SYSTEM MUST RECEIVE CUES FROM ALL SIX SOURCES SHOWN. THE NEW AMES SIMULATOR WILL PROVIDE ALL THESE CUES EXCEPT REDUCED CABIN AIR PRESSURE.

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Ames 65-13
April 29, 1965

The fastest shot ever fired has been rammed out of a 20-foot-long, light-gas gun at NASA's Ames Research Center near Mountain View, California

The shot set a world speed record of 25,300 miles per hour for controlled flight of a visible object, of known mass and shape, and over a known distance in a ground facility.

- more -

The ability to move objects this fast applies directly to space flight problems because it gets into the range of extremely high speeds at which small meteorites hit spacecraft hulls, the space suits of astronauts, and the walls of space stations.

The record shot is also a "hardware triumph" in advancing the development of hypervelocity guns. These devices are used for research in entry into the atmospheres of the Earth and planets, in properties of gas flow around solid objects, to study materials under super speed conditions, and to check theories of high speed impact.

The .05 gram, .22 caliber polyethylene cylinder (about one-third the size of a shirt button) made its flight down a horizontal 20-foot-long vacuum flight range. Its 25,300 mph speed was about 700 mph faster than the speed needed by a spacecraft to escape from the Earth's gravity into the solar system.

The plastic projectile blasted out a crater in its target (a block of hard aluminum) about three-quarters-of-an-inch across and three-tenths-of-an-inch deep.

The shot was about 3,200 mph faster than the previous record for ground-based controlled projectile flight.

- more -

Elated hypervelocity flight researchers at the Ames Center say the record shot marks a milestone in high speed research.

These researchers work constantly to get higher speeds in their guns, "and this is the highest one yet," they comment.

The light gas gun used in the shot works something like a child's pop gun. An explosive charge is set off in a cylinder behind a plastic piston. The explosion pushes the piston into a chamber of hydrogen gas, compressing it, and the gas in turn pushes the spacecraft model or projectile out of the firing tube. A light gas (hydrogen is the lightest) must be used because it has a low mass and will expand at the highest speed after compression.

In the cylinder behind the model, the gas pressure is about a half million pounds per square inch, and forces on the rapidly accelerating model are several million times the force of gravity.

B. Pat Denardo, Ames research scientist, was in charge of the shot. He points out that the success was part of a series of shots aimed at impact studies, and also at greater speeds.

"We had just put in a new launch tube, and we decided to try a speed run. We sure got one," he comments.

- more -

The model, he explains, was photographed vertically and horizontally from five camera stations. Time of travel between stations was measured to within one one-hundred-millionth (1/100,000,000th) of a second.

"Documentation on the speed run is complete," he says.

The model was .22 inches in diameter and .07 inches thick. It hit the target with zero angle of attack, "right square on." This indicated virtually perfect firing technique, he says.

Super speed runs of this type depend on skills built up with a great deal of practice. The present model of the gun was developed at Ames about four years ago.

The launch tube must be honed "like glass" to absolute smoothness. There is a difficult sealing problem because of the half million pounds of pressure in the gun. Sometimes the polyethylene piston breaks a solid steel cylinder because of its great striking force.

Many members of the Hypersonic Free Flight Branch at Ames have contributed techniques and ideas for improvements since the Center began building high speed guns in 1949.

"In those days," Mr. Denardo recalls, "4,000 miles per hour was considered really top speed."

- more -

For the record-setting shot, the vacuum flight chamber was pumped down to 1/700th of normal atmospheric pressure.

- end -

Ames 65-13

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Ames 65-16
July 2, 1965

To ARC Release

CONTRACT LET FOR ADVANCED FLIGHT SIMULATION LABORATORY

Scientists expect to study most of the NASA flight programs planned for the next 20 years long before they happen--in what will be among the most advanced flight simulation laboratories ever built.

A $3,200,000 contract has been let for construction of the new 93,000 square foot laboratory building at NASA's Ames Research Center near Mountain View, California. Total value of four major facilities to go inside the structure will be $10,068,000.

Inside the new building, men will be shunted about, shown projections of star fields, and made to sense a range of pressures,

- more -

temperatures and vibrations in research on human factors shaping both aircraft and spacecraft flight.

The new structure will contain the most advanced aircraft simulator known (for supersonic transport studies).

It will also house: the most powerful centrifuge yet built (up to 50 times the force of gravity); a mid-course navigation facility where stars and planets can be projected just as they are seen by space pilots; and a "virtually frictionless" satellite attitude control facility.

"Simulators like these can duplicate actual flight long before it happens, at very low cost, with great safety, down on the ground. They are among the best research tools we have," commented Dr. Smith J. DeFrance, Director of the Ames Research Center.

Contract for the new laboratory building has been awarded to the E. A. Hathaway Company of San Jose, California. Completion date is July 25, 1966. Architects are Skidmore, Owings, and Merrill of San Francisco.

Field installation of the laboratory's new $6.5 million "50-G" centrifuge or Man Carrying Motion Generator, will begin in January 1966. Genisco Technology Corporation of Compton, California, is prime contractor with Westinghouse Electric Corporation, Pittsburgh, Pennsylvania, as subcontractor for motor and other electrical equipment.

"Except for weightlessness, we will be able to present the 'crew' of the new centrifuge and its associated mid-course navigation facility with the entire range of experiences for flights to the moon or Mars," comments Russell G. Robinson, Assistant Director of the Ames Research Center for Aeronautics and Flight Mechanics.

The three-man cab on the centrifuge will produce five of the six possible types of motion, and will present the crew with all the environmental stresses and sensations of space flight.

It will impose on them the acceleration forces of launch and reentry, plus cabin pressures and temperatures of actual flight.

The three-man cab will be as well equipped as an actual spacecraft with all systems and instruments, including a computer.

Crew members will encounter all "out-the-window" stimuli of space flight, such as radiation from the sun in space, and celestial objects needed for navigation.

The flight experience possible with the new machine also will include unsuccessful missions. It will produce the high gravity forces of

- more -

emergency termination of a mission (calling for immediate reentry). Cab equipment will simulate failure of the cabin atmosphere system, heat and pressure buildups, changes in humidity and cabin gas mixture, explosive decompression, and others.

The three-man cab will not be used at over 20 times the force of gravity. This is the extreme limit of sustained gravity tolerance for practical space flight. (Highest "G" on the Gemini mission was eight.)

A smaller one-man cab designed for physiological and psychological experimentation will be able to function at from zero to 50 times gravity. However, flight of any duration at these tremendous forces is extremely unlikely without radical new systems to increase human tolerance. The one-man cab will be used to study such systems, and to gain basic data on human reactions to a variety of conditions under extreme forces.

The new centrifuge will be housed in a 124-foot-diameter rotunda, occupying 12,500 square feet. It will be powered by a DC motor with a peak rating of 18,600 horsepower. This is believed to be the most powerful DC motor ever built. There will also be electrical equipment to handle a 13,800 volt power input.

To simulate mid-course portions of a space flight, a 7,000 square foot Mid-Course Navigation Facility will be installed in the new lab. This

- more -

facility will also contain a three-man capsule. It will have three screens for projection of various portions of the heavens. It will also contain a precisely calibrated surface on which stars and planets will be pinpointed with great accuracy (to one-thousandth of an inch). Their light will be transmitted in parallel beams as starlight moves in space. "Crewmen" will use this surface to make actual navigation sightings.

Installation of the four-story Advanced Aircraft Simulator in the new simulation lab will begin in November of this year. Contractor for the 35-ton, $1,562,000 aircraft simulator is American Machine & Foundry Company of York, Pennsylvania.

The aircraft simulator will also have a three-man cab with operating instrument panels and "actual" crew stations. It should be able to duplicate virtually all aspects of a complete supersonic transport flight from takeoff to landing, as well as flight by most other types of aircraft.

The aircraft simulator will produce all six possible types of motion, and will be unique in having 100 feet of lateral motion. This will allow it to duplicate the large yawing movements expected with supersonic transports. Pilots will feel all the motions of flight and a picture of the changing landscape below will be projected on a large screen ahead of them.

- more -

The new device will provide answers to such questions as how to divide up among crew members the work of running the aircraft, how much aerodynamic stability must be built into the plane, best kind of control system, and requirements for hydraulic and electric systems.

Construction of the new laboratory's 5,200 square feet Satellite Attitude Control Facility will also get underway in November of this year. It will cost $1,110,000 and is being built by American Optical Company of Pittsburgh, Pennsylvania.

Purpose of this simulator is to provide a means of testing advanced attitude control systems in a realistic space environment. For this, a 22-foot-diameter, spherical vacuum chamber (to 1/2mm of Mercury) will be built to simulate the vacuum of space. It will have a finely-balanced eight-foot-diameter test table at its center on an almost frictionless air bearing (moving parts "float" on a cushion of air).

An "earth simulator" system will rotate around the chamber to simulate the Earth as seen from a satellite. This will simulate all types of orbits with apogees out to 10,000 miles and rotation times up to one day. The chamber will also contain three star simulators, adjustable up to sixth magnitude.

- more -

The facility also will have coils to simulate the Earth's magnetic field in space, and a heater to provide Earth infrared radiation. Provision has been made for a future simulated sun. Together these systems will make actual satellites react as though they were orbiting in space, and scientists can observe their stabilization systems in action.

In addition to these specific facilities, the new Ames Advanced Flight Simulation Laboratory will contain medical support facilities, observation rooms, a computer room, control rooms, shops, and an equipment annex.

The structure itself will consist of a two-story portion with basement, housing offices, computer facilities, and electronic areas. There will be a high bay for the aircraft simulator and the centrifuge rotunda.

The building will be of reinforced concrete with an entrance of anodized aluminum and glass. There will be two hydraulic elevators, and various overhead cranes.

- end -

Ames 65-16

FOR IMMEDIATE RELEASE

Home Phone:
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Ames 66-10
July 20, 1966

(Note to Editor: This story is also being released from NASA Headquarters in Washington, D. C.)

FASTEST FLIGHT TUNNELS KNOWN GO OPERATIONAL AT AMES

A major facility able to simulate return flight into the Earth's atmosphere from the moon or planets will be fully operational by the end of the month.

The new Hypervelocity Free Flight Facility at NASA's Ames Research Center, near Mountain View, California, contains three huge light gas guns which can fire free-flying spacecraft models at 20,000 miles an hour.

The scale models of actual spacecraft fly into an air stream flowing at 10,000 mph from the opposite direction. This combined speed of 30,000 mph is far above "escape speed" and is fast enough to simulate Earth return stages of many of the planet missions now under consideration, as well as entries into planet atmospheres.

- more -

These speeds also represent the fastest aerodynamic simulation known. Other facilities for attaining partial simulation of very high speed flight have reached speeds only about half as fast.

The tunnels will be used in testing many future U. S. spacecraft.

Atmosphere reentry speed for spacecraft coming back from the Moon is 24,500 mph. Minimum and maximum practical speeds for spacecraft returning from planet missions will range from about 28,000 to 44,000 mph.

The team which developed the tunnels is led by Thomas N. Canning, chief of the Hypersonic Free Flight Branch at Ames.

The new facility uses free-flying, one-inch or one-and-one-half inch diameter models. Increases in tunnel air pressure are employed to make models behave as though they were full-scale spacecraft.

The models are photographed many times at millionths-of-a-second exposures during each flight. These "shadowgraphs" permit precise determination of the models' motion (speed, deceleration, pitching, yawing, rolling, and swerving).

- more -

Shadowgraphs and other measurements provide determination of full-scale flight characteristics and heating rates for altitudes above 100, 000 feet. (These are the altitudes where slowing down from space flight speeds is accomplished, in order to land safely on Earth.)

The new 30, 000 square foot facility contains three major tunnels: an aerodynamic tunnel to study spacecraft flight characteristics; a radiative heating tunnel to study heating characteristics; and a gun development tunnel to improve launch guns.

All three tunnels use light gas guns to attain the highest controlled speeds yet reached under laboratory conditions.

These guns work by using ordinary gunpowder to drive a plastic piston down a long tube. The piston compresses a charge of hydrogen to pressures in excess of 200, 000 pounds per square inch so quickly that the temperature rises to about 8, 000^{o}F. The hot hydrogen is an exceedingly efficient propellant for pushing the model down the launch tube because it uses only a small amount of the energy it receives from the piston to accelerate itself. A great deal of energy is left over to continue pushing on the model, even after it has attained very high speeds.

- more -

The largest of the three tunnels, the aerodynamics facility, is 460 feet long and illustrates the features of all three tunnels. It works as follows:

To fire the gun, a charge of ordinary gunpowder is ignited behind a polyethylene piston at one end of the 90-foot-long, six-inch-diameter pump tube of the gun which contains hydrogen gas. The piston moves down the pump tube at the speed of an ordinary 30 caliber rifle bullet (about 1, 700 mph) and compresses the hydrogen to a peak pressure of around 300, 000 lbs. per square inch.

As the pressure in the pump tube rises above 20, 000 lbs. per square inch, the diaphragm behind the model breaks and the hydrogen, heated by compression, pushes the model down the 30-foot launch tube and into the test section at 20, 000 mph.

Meanwhile, at the other end of the tube, the counterflow system is ignited. This is a shock tube consisting of a 75-foot driver made from two 16-inch naval gun barrels, and an 85-foot shock tube section, made from three 14-inch naval gun barrels.

- more -

The shock tube driver section is filled with a combustible mix of hydrogen and oxygen, diluted with helium. The mixture is ignited and a few milliseconds later, a command, timed precisely with model launch, ruptures the diaphragm which separates the driver and shock tube sections.

The driver gas then enters the shock tube and compresses the air in the tube into a small volume next to the nozzle entrance, heating this air to about 9,000°F.

The air expands as it leaves the nozzle and moves into the test section at 10,000 mph. It completely fills the test section with steady flow for .02 seconds. This is long enough for the spacecraft model, coming the other way, to fly the complete length of the test section in uniform conditions. This flow time includes about five milliseconds leeway for errors in timing, "...plenty of time for acceptable coordination of firing events," according to Mr. Canning.

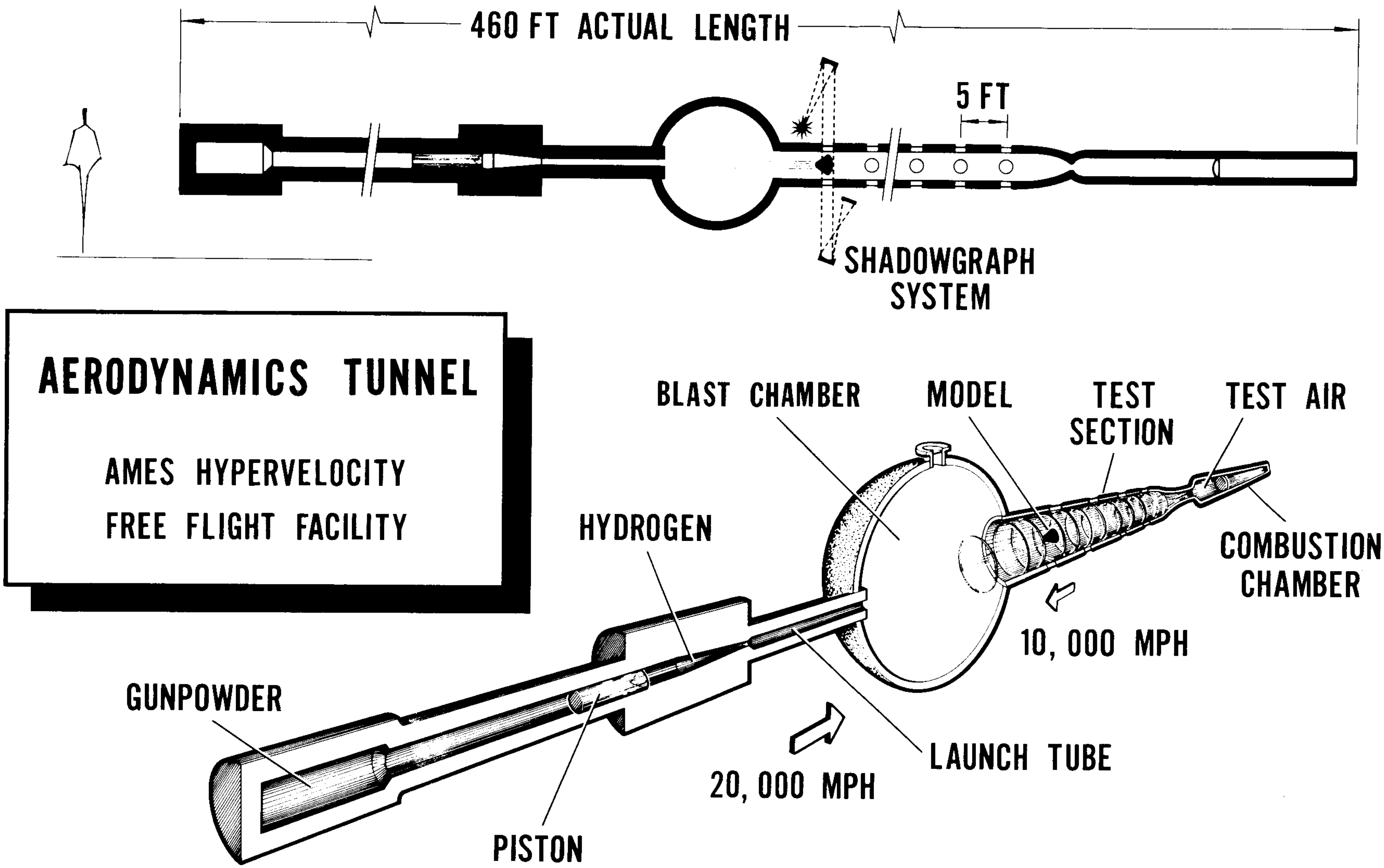
The flight section is 75 feet long and three feet in diameter. There are two camera stations every five feet, a total of 16 pairs, and the cameras photograph the model bottom and side every 160 microseconds as it flies past. Cameras use exposures of one 20-millionth of a second. These almost infinitesimal exposure times are required to "stop" the model traveling at 20,000 mph. They are made possible by complex electronics.

- more -

The counterflow radiation heating tunnel works in basically the same way as the aerodynamic tunnel just described.

Each flight uses air of a selected density to simulate a given part of the atmosphere entry path; and speeds, air density, and model shapes are varied to study various spacecraft characteristics.

- end -



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FOR RELEASE: October 18, 1966
Tuesday PM's

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Ames 66-13
October 15, 1966

NASA SCIENTIST PROPOSES METHOD TO "TURN OFF" TORNADOES

An explanation of the tremendous forces that drive tornadoes-- a possible "tornado-killing" technique-- and a working laboratory model, showing how tornadoes form and how they might be "turned off" were announced today.

Dr. Vernon J. Rossow, a scientist at NASA's Ames Research Center, near Mountain View, California, described his new approach in a paper today at the 12th Weather Radar Conference at the University of Oklahoma in Norman, Oklahoma.

The NASA scientist stressed that despite promising results with an actual "tornado model", so far he has only a theory. A test on an actual tornado will be needed to prove whether his views are correct.

Dr. Rossow proposes that tornadoes are caused by electrical forces. The flow of powerful streams of water droplets between positive and negative

-more-

cloud cells, he suggests, provides the enormous power to drive a tornado.

The scientist's "tornado-killing" proposal calls for use of a 40 mm. cannon to fire many pre-wound wire projectiles at the tornado cloud. This would stretch a thin wire two miles or more between the positive and negative cloud cells.

A lightning bolt would result, neutralizing the two clouds and, in effect, "shorting out" the electric field in the storm clouds which created the tornado.

Dr. Rossow, who was reared on a farm in Iowa and watched formation of numerous storms, comments that the often-described "freight train roar" of tornadoes is partly electrical noise similar to the crackling sound from many electrical arcs.

To produce miniature four-inch-high tornadoes in his laboratory, he whirls small clouds of steam with an electric field analagous to a storm-cloud field.

The new tornado theory appears to account for all the known characteristics of tornadoes, including the eerie light generated within the whirling column.

Data on tornadoes is hard to come by because of the disruption in human activities they cause.

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The researcher spent four years collecting data and doing mathematical analyses of storm cloud forces. His theory is as follows:

Tornado vortices (funnels) appear to begin within intensely active storm clouds. Unlike a hurricane, the 400-yard-thick funnel rotates either to the right or left at a maximum velocity of up to 500 mph. After starting in the cloud, the funnel dips down, attempting to attach itself to a solid surface (the earth).

(This dipping-down is a known characteristic of vortices, also seen in jet engine and wind tunnel studies.)

Large electric fields are known to be associated with tornadoes.

The key question has been: What is the source of the tremendous spin velocity of a tornado?

Dr. Rossow eliminated a number of sources, coming finally to electrostatic motor action.

Tornadoes, he says, are produced by two large cloud masses of positive and negative water droplets, parallel to each other about a mile apart within storm cloud regions. (Such positive and negative masses cause lightning.)

If turbulent storm-cloud eddies produce a flow of positively-charged droplets from the positive mass of droplets into the negative mass, this

-more-

usually forces a second counter flow of negative droplets across to the positive droplet cloud region.

The flow between the two charged regions takes place because the two masses (positive and negative) are mutually attracted.

If these two counter-flowing streams, each moving at up to 500 mph occur side by side and a quarter to a half-mile apart, the result is frequently a tornado.

Water droplets and air between the two counter-flowing streams begin to whirl faster and faster, building up to rotational speeds as high as 500 mph.

The tornado vortex then begins to move in one direction or the other down the corridor between the charged cloud masses in order to get a continuing supply of positive and negative particles. (Local particles neutralize each other as soon as they mix.)

Once started, and if the positive and negative cloud masses are large enough and properly aligned, the tornado whirls until the charged particle supply runs out.

The original vortex imparts its rotational energy to surrounding air and water droplet regions and seeks to attach its end to the earth, with well-known results.

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The distance between the cloud and the ground ranges from 2,000 to 5,000 feet. The vortex may go much higher in the cloud. How high is unknown.

To kill a tornado, Dr. Rossow proposes to fire a number of wire-bearing projectiles (spools) through the top of a tornado. One end of the thin .003 inch wire would be anchored by a small parachute. The wire would unroll from the spool, pass between the positive and negative cloud masses, and trigger an immediate discharge (lightning bolt), neutralizing the charge between the two masses and stopping the tornado by removing its energy source. The lightning charge cannot jump the gap of a mile between the charged masses in a cloud without a wire to start it.

Light observed in tornadoes comes from the tiny sparks emitted as each positive droplet meets a negative droplet.

In his laboratory, the Ames scientist uses a steam jet and two parallel grids that can be charged with electricity at 20,000 volts. When current is switched on, and steam is flowing from the jet, the grids produce positive and negative droplet masses and a water droplet vortex immediately appears. It spins very fast until the power is switched off, when it stops abruptly. The power would be switched off in a real tornado by neutralizing the two charged masses.

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Dr. Rossow is a fluid mechanicist. He came to tornado analysis through magnetohydrodynamic work, the study of electrical and magnetic forces on fluids.

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Ames 66-18
December 16, 1966

APPRENTICE SIGN-UPS AT AMES

Young men can get an opportunity to learn fabrication, electronics, instrumentation, wind tunnel and other space age skills by taking an apprenticeship examination at NASA's Ames Research Center.

The National Aeronautics and Space Administration Center at Moffett Field is now conducting examinations for appointments to the four-year apprenticeship program in a variety of trades. These include: Electrician, Experimental Electronic Instrument Maker, Experimental Electronics Mechanic, Experimental Facilities Mechanic, Experimental Machinist, Experimental Metal Fabricator, Experimental Metalsmith, Experimental Modelmaker, Research Aircraft Mechanic, and Research Instrument Maker.

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Appointments for those selected are most likely to be in the Ames Machine Shop, Mechanical Instrument Branch, Structural Fabrication Branch, Electronic Instrument Branch, or one of the many wind tunnels at the Center.

As beginners in skilled trades, the apprentices will get instruction at the NASA Center's apprenticeship school. They will draw mechanical shop assignments in the rudiments of trade tasks. They will study shop subjects (mechanical drawing, mathematics, blue print interpretation and others).

Machinery and materials of their trade will be covered, and they will perform elementary trade tasks under the supervision of a shop instructor.

No experience is required, but applicants must take a written test. This will consist of questions in arithmetic, algebra, geometry, physics, and will require about three and a half hours.

Prospective apprentices can write or call the Board of Civil Service Examiners at NASA's Ames Research Center, Moffett Field, California 94035, for information about the test. Sample test questions and cards of admission to the test then will be mailed to them.

Successful completion of the four-year course will earn the apprentice an apprenticeship certificate and make him eligible for appoinment as journeyman mechanic in his trade.

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Ames 67-2
March 7, 1967

LOCAL FEDERAL AGENCIES WILL LAUNCH NEW ATTACK ON EQUAL OPPORTUNITY PROBLEMS OF MINORITIES

Five federal agencies on the San Francisco peninsula have joined to step up the drive against minority discrimination within the Executive Branch of the U. S. Government.

The program, it is believed, is unique in being cooperative and in aiming at all supervisors. It will reach nearly every supervisor, about 600 of them, of the five participating agencies. It will provide an intensive two-day briefing -- without hindering work at the agencies involved.

Five two-day symposiums with over 100 supervisors at each are planned. They will be staffed by industrial, academic, and other experts

-more-

on equal opportunity problems. The first will be at the National Aeronautics and Space Administration's Ames Research Center, Moffett Field, Wednesday and Thursday, March 8 and 9.

Previous federal agency programs of this type have been on a much smaller scale.

The program is jointly sponsored by Ames; the Veterans Administration Hospital, Palo Alto; the U. S. Geological Survey, Menlo Park; the Naval Air Station, Moffett Field; and the Naval Plant Representative's Office, Sunnyvale.

The five-agency sponsorship will allow about one-fifth of the supervisors from each organization to attend one of the two-day programs, without tying up all of the supervisors from any one agency at any one time. Attendance from five different agencies should allow a wide exchange of views.

Speakers and subjects at the first session will be: Mr. Loren Bright, Executive Assistant to the Director of Ames, on "Opportunity and the Federal Manager"; Dr. Stanford Lyman, Chairman of the Department of Anthropology and Sociology, Sonoma State College, on "Race and Employment, the Historical Record"; Dr. Carlton Goodlett, Publisher, Sun-Reporter, San Francisco, on "Right to a Job"; Mr. Leno Lopez, Mexican-American Community Services Project, Santa Clara, on

"Rights Now - Not Manana"; and Mr. Stanley Hawkins, Manpower Development Coordinator, Lockheed Missiles and Space Co., on "Industry Participation".

Panelists from the sponsoring agencies and Mrs. Carol Asch, Personnel Officer, Office of Economic Opportunity, will conclude the second day's program with a round-table discussion. Another 21 experts from various organizations have served as a resource group for the effort.

The conferences will seek to bring out facts on discrimination from scientific, social, and historical viewpoints. They will seek to combat discrimination against minorities based on race, creed, religion, color, or national origin. They will inform supervisors of the policies of the federal government opposing discrimination. They will cover both discrimination in hiring, and in promotion within the organization.

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Ames 68-3
January 24, 1968

EXPLANATION OF GREAT RED SPOT
OF JUPITER ADVANCED BY AMES SCIENTIST

An explanation of the gigantic red spot on the planet Jupiter has been proposed by researchers.

(The huge oval red spot on the top of Jupiter's atmosphere is the most prominent feature on the planet. It is 8,000 miles wide and 30,000 miles long, large enough to engulf several Earths with ease.)

Dr. Cyril Ponnamperuma and Fritz Woeller of the Ames Research Center of the National Aeronautics and Space Administration, near San Francisco, have advanced the explanation as a result of previous Jupiter experiments. These have suggested that building blocks of life, or life itself, could exist on Jupiter.

The great red spot, which lies halfway between the equator and the pole in the southern hemisphere of the giant planet, they suggest, may well be millions of square miles of a red organic dye.

The dye, they believe, is the most obvious chemical explanation of the red spot.

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In their studies, they have made a very large number of electrical energy discharges (lightning) in a simulated Jupiter atmosphere of ammonia and methane. This is the atmosphere mix agreed to by most scientists. These experiments have produced quantities of amino acids and other organic materials. But, by far the commonest product has been an organic dye stuff, with a ruby red translucency.

The scientists agree with other Jupiter specialists that the great red spot may result from a geographical feature. A giant meteor crater in the solid hydrogen surface of Jupiter could create a vortex in the atmosphere. Since Jupiter's atmosphere may be largely red dye, upwelling caused by the vortex would create the red spot in the top of the dense surrounding white clouds.

The red spot has slipped back .4 of a planet rotation in the past 100 years. It has been observed continuously since discovery in 1831 by S. H. Schwab.

The great red spot seems unrelated to localized energy sources. Tremendous surges of radio emissions from Jupiter do not coincide with the red spot but seem related to motions of the moon, Io.

Jupiter is somewhat like a huge dynamo, rotating once every ten hours. This rapid alternation of day and night, and hence warm and cold, is believed to produce great atmospheric turbulence and electrical energy transfer.

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Some other chemical explanations have been advanced, but the red dye reaction is the most direct result of energy applied to Jupiter's atmosphere as it is defined by spectroscopic and theoretical studies.

The Ames experiment always produces the red dye, from room temperature to minus 300°F. The dye is soluble in some solvents, but unstable when dissolved and not frozen. It appears to be a complex mixture of compounds, all with a common feature such as carbon-carbon bonds. The Ames findings were presented at the recent International Biochemistry Congress, Tokyo, Japan.

The researchers are attempting to further identify composition of the dye by spectroscopic analysis. Spectroscopic studies by telescope of the red spot from the Earth have so far produced little evidence on composition.

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Ames Release 68-4
January 30, 1968

SCIENTISTS ADD LAST MAJOR CATEGORY OF COMPOUNDS IN EXPLAINING CHEMICAL ORIGIN OF LIFE

The means by which chlorophyll may first have appeared on the Earth has been demonstrated by scientists at the Ames Research Center of the National Aeronautics and Space Administration near San Francisco.

Chlorophyll is the energy conversion molecule in green plants which is essential to all life on Earth. It turns the radiant energy of sunlight into chemical energy for use by living organisms. All animals, including man, depend on food created from carbon dioxide and water by green plants using chlorophyll.

The Ames scientists appear to have synthesized the organic ring molecules, known as porphyrins. Chlorophyll is a porphyrin molecule as is hemoglobin, the oxygen-carrier in the blood. The porphyrin ring structure in chlorophyll has characteristic molecular side chains and a magnesium atom in its center.

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The Ames synthesis retraces the path of chemical evolution of life--the idea that beginning about 4.5 billion years ago, the ammonia, methane, and water of the Earth's primitive atmosphere were continuously activated by energy from solar ultraviolet, electric discharge (lightning), and heat. Over a billion years or more, these reactive molecules formed first the building blocks of life and then simple living systems. Most scientists concur in this explanation of the origin of life.

The other major categories of life building blocks previously have been synthesized by chemical evolution methods, but until now no porphyrins had been found.

The work was done by Drs. Gordon W. Hodgson and Cyril Ponnamperuma. Dr. Hodgson, a Senior Research Associate at Ames, is on leave from the Research Council of Alberta, Canada, where he heads petroleum research . He is an authority on porphyrin synthesis. Dr. Ponnamperuma, Chief of the Chemical Evolution Branch at Ames, has previously demonstrated chemical evolution of ATP (the energy storage molecule), genetic code chain constituents, proteins, and other life building blocks. The work was reported in the Proceedings of the National Academy of Sciences, January 30, 1968.

The porphyrin synthesis is confirmed by a battery of tests. However, the scientists caution, there is an outside possibility that the materials are not true porphysins, but structurally related compounds.

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The synthesis was done as follows: the ammonia, methane, and water of the simulated primitive atmosphere were subjected to a continuous electric arc (lightning). This caused the original molecules to combine into many new ones.

A small amount of the resulting material was identified as porphyrins. It absorbed light of 400 millimicrons wavelength, characteristic for porphyrins. It was extractable by an aqueous acid from organic solvents. By putting it through molecular sieve gels, it was found to have the proper molecular size. When excited by a high energy light beam, it produced fluorescent light at 685 millimicrons, a very specific test. Addition of copper suppressed the fluorescence, another very specific test.

The porphyrins are believed to have allowed survival of life, once it appeared.

During the first one billion years of the Earth's estimated 4.5 billion year history, the solar ultraviolet, lightning, and heat (from volcanoes) caused accumulation of large amounts of life building block material in the primitive oceans. Long-chain, carbon-based molecules, which could reproduce themselves by using this accumulated supply of life building blocks, appeared first. These "living" molecules had no energy conversion mechanisms.

As they used up the accumulated supply of "food" (building block chemicals), life was threatened with extinction. To survive, life then had to employ directly the continuous flood of sunlight to make its own food.

- more -

Such a new, direct means of energy utilization was provided by the chlorophyll molecule, along with the operations of several enzymes (super catalysts). This molecule could convert radiant solar energy into chemical energy which the organisms could use to make new living material. These organisms were the first plants.

The Ames scientists believe these early organisms used the porphyrins previously accumulated in the primitive oceans to make the first chlorophyll.

In two other events, plant-created oxygen eventually replaced the ammonia-methane atmosphere, and the ozone layer at 15 miles shut out the solar ultraviolet, the most important early energy source.

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Ames Release 68-9
June 18, 1968

EXPLORING THE LUNAR INTERIOR

Methods to find deposits of ice, a permafrost layer, caves, or bodies of ore beneath the lunar surface, and to determine the overall structure of the Moon and the temperature of its core have been outlined.

During working group sessions at NASA's Ames Research Center, near San Francisco, co-sponsored by the University of California, Berkeley, some 90 of the nation's experts discussed the electromagnetic exploration of the Moon.

Attendees pointed out that many scientists believe there is water on the Moon. They said that on Earth proven electromagnetic methods currently find bodies of ore, water, and other formations far beneath the surface.

They commented that electromagnetic systems will provide the best information on the Moon's interior, and recommended three main techniques from about a dozen proposed: magnetometer systems, radar, and radio-frequency systems. These could be deployed from Earth, from lunar orbit, or from crawlers or emplacements on the lunar surface.

Magnetometer systems could explore the deep interior of the Moon, using a network of emplacements on the surface. These would measure the amount of blocking of the fluctuating solar magnetic field as it passed through the Moon, borne by the solar wind. A highly-conductive hot lunar core would cut off the field completely. A cold core would let most of the field pass through. A magnetometer mounted on a lunar crawler could make similar measurements to find highly conductive masses of water, lava, or ore.

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Radiofrequency probes were described as the means to make the lowest cost subsurface surveys. Such a probe on a spacecraft in 50-mile polar orbit could make a global survey of the Moon at depths from half a mile to five miles down. It would require a 500-yard-long antenna, similar to that just completed for the REA satellite.

Radio signals from the spacecraft would penetrate the surface and bounce back to the spacecraft where changes in their wave characteristics would be measured.

These wave-change data could be used to define bodies of ore, ice deposits, or permafrost. A similar system could be mounted in a crawler.

A third system, high-frequency radar, could make detailed studies of the lunar surface at depths of from one to ten yards. Radar could be bounced off the Moon from the Earth. It could be beamed from a spacecraft in lunar orbit or from a lunar crawler at the lunar surface, to bounce off and be received by antennas on the Earth, or lunar crawlers could beam it into the surface and receive the returning signal.

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(Note: This story is also being made available to news media at Cape Kennedy and the Manned Spacecraft Center, Houston.)

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Ames Release 69-8
May 15, 1969

ASTRONAUT PILOT CAN NOW FLY HUGE SATURN V INTO ORBIT

An astronaut pilot will, for the first time, be able to control the 36-story, six and a half million pound Apollo-Saturn V vehicle as it flies into orbit on the Apollo 10 mission.

The manned guidance system is a backup for the normal automatic guidance of the Saturn V, and will be used only if necessary.

However, the flight marks the first time manned control of a large rocket will be possible. Addition of the piloted backup will increase reliability of the guidance system.

During first stage burn, spacecraft commander Thomas Stafford will be able, if necessary, to switch quickly to a backup automatic system.

During second and third stage burns of Saturn, he can, if required, fly the huge vehicle like an airplane. He will have a course to follow. He will use a control stick to correct his flight path to adhere to that course.

The system is the result of five years of work on piloted control of large boosters at NASA's Ames Research Center, near San Francisco. Ames engineers have worked closely on the system with the Manned Spacecraft Center, Houston, and the Marshall Space Flight Center, Huntsville, Alabama.

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Astronaut Pilot Can
Now Fly Huge Saturn V
Into Orbit

The system involves reprogramming computers, and new ways of using existing components and control circuits.

Astronauts Frank Borman, Neil Armstrong, and Stuart Roosa, among others, have flown the Apollo-Saturn V into orbit on an Ames simulator. They have learned the routine easily.

Essentially, if the regular guidance components (gyroscopically stabilized platform, accelerometers, and computers) in the Saturn V should fail, the astronauts could use the backup components in the Command Module, along with pilot control decisions, to fly the vehicle into orbit with acceptable accuracy.

From first stage burnout until injection into orbit, the pilot uses four pre-tabulated sequences of numerical values. These show four desired flight conditions: (1) pitch attitude, (2) velocity, (3) altitude, (4) rate of climb. He progressively checks these precalculated values against the actual values for spacecraft position, provided by the Command Module computer and displays. He does this over and over as flight conditions change with time from launch.

Where corrections are necessary, he uses the Command Module control stick to change direction until the right values appear.

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FOR RELEASE IN P. M.'s,
November 5, 1969

Ames Release 69-13
November 5, 1969

LARGE-SCALE AIRCRAFT FLIGHT SIMULATOR PUT IN OPERATION

Faster and larger jet transports lie just over the horizon. An important factor in their design will be to assure safe control by their pilots.

To provide research data on handling characteristics of these advanced aircraft, the National Aeronautics and Space Administration has put into operation a new piloted simulator.

The $2. 6 million, six-story high machine, known as the Flight Simulator for Advanced Aircraft (FSAA), is at NASA's Ames Research Center in Mountain View, California. It is believed to be the most capable piloted aircraft flight simulator ever built.

The FSAA provides pilots with a simulation experience virtually identical to actual flight. Like other simulators, it is far cheaper to operate than prototype aircraft. It can duplicate almost any desired aircraft. Critical flight and control situations from engines-out to low-visibility landings can be done with complete safety on the ground.

The FSAA, by far the largest piloted aircraft flight simulator ever built, consists of a very large machine which generates motions in all of the six possible

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rotational and linear motions. Atop this motion generator is a three-man cab, which can be fitted out to duplicate the environment of the flight deck of a typical transport aircraft. This includes out-the-window view, engine and mechanical noises, vibration, and realistic stations for a three-man crew with operating instruments.

In some future jet transports, the pilot may be as much as 150 feet forward of the plane's center of rotation. As the plane yaws or pitches around this rotational center, cockpit motions will be produced that may not coincide with the plane's flight path. These motions can be duplicated and experienced in the new simulator so that pilots can learn to handle them.

The motion-generator has 100 feet of lateral motion, ten feet of vertical motion, and eight feet of forward and back motion. These motions are combined with pitch, roll, and yaw motions to simulate response realistically.

The FSAA is run by a unique, general-purpose, digital-analog computer. Flight characteristics of virtually any aircraft can be programmed into this computer.

The simulator also uses a small color TV camera, which "flies" over a model of countryside containing an airport. The changing landscape it "sees" is projected in color on a screen in front of the pilot's window. This makes him feel he is maneuvering over the projected landscape, and landing or taking off as the camera makes these maneuvers.

The FSAA simulates nearly all flight situations except those involving high accelerations or aerobatics. It provides the periodic bumps of tar strips on runways, the initial big bumps of touchdown, climb-out attitude of take-off, restricted visibility, and turbulent air conditions.

In providing design data for advanced jet transports the FSAA would answer such questions as how to divide up among crew members the work of running the aircraft, how much inherent stability the plane must have to be flown by human pilots, best kind of control system, and requirements for hydraulic and electrical systems.

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The FSAA works as follows:

The pilot is assigned a general flight task. In flying the task, he introduces control actions which result in attitude and flight-path changes of the aircraft. These responses are converted to simulator movements in the various axes of motion--and also to operation of sight and sound simulation devices. This is done by the computer program, which also contains the characteristics of the airplane being simulated.

The pilot sees, feels, and hears the consequences of each control action, and thus flies the simulator as if in true flight.

The capabilities of the FSAA are such that it could be used to simulate the aerodynamics of hypersonic and supersonic flight by reentry vehicle concepts such as space shuttles.

Design of the simulator was by Ames engineers John Dusterberry, Maurice White, and Shizuo Doiguchi.

The FSAA, like the other ten Ames flight simulators, will be "flown" by research pilots to obtain pilot-handling data. Such data represents basic guides for the design of new aircraft or for the evaluation of those already built.

# # #

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FOR IMMEDIATE RELEASE

Ames Release 69-14
November 7, 1969

SCIENTISTS WILL USE THE APOLLO MAGNETOMETER TO STUDY THE LUNAR INTERIOR

Scientists expect to be able to study the interior of the Moon once the lunar magnetometer is emplaced on the surface by the Apollo 12 Astronauts on November 19.

The investigators at NASA's Ames Research Center near San Francisco will employ a combination of: the magnetometer itself, one Moon-orbiting and one Sun-orbiting spacecraft, plus the turbulent solar magnetic field which sweeps out from the Sun and through the Moon at about one million miles per hour.

The researchers expect that the experiment will enable them to calculate conductivity profiles on constantly-changing cross sections of the Moon for 14 days per month.

These electrical conductivity profiles should allow close estimates of composition, temperature, and physical state of the Moon's interior (solid, liquid, or some mixture).

The magnetometer instrument will measure direction, gradient, and intensity of magnetic fields on the lunar surface three times per second for a year.

How can scientists study the lunar interior by measuring magnetic fields?

Since the Moon has no magnetic field of its own, the interplanetary field streams right through it. The field is carried out from the Sun by the electrically-conductive ionized gas (hydrogen and helium nuclei) of the million-mile-an-hour solar wind.

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As the solar field approaches the Moon, the "anchored IMP" (Explorer 35) spacecraft will measure it from lunar orbit. Pioneer 9, in solar orbit, will provide further measurements of the incoming field.

Since the magnetic field is generated on the boiling surface of the Sun, it fluctuates rapidly and widely. In passing through the Moon, this moving field sets up electric currents inside the Moon, just like those induced in the copper wires of a generator when they move through a magnetic field.

These currents inside the Moon in turn set up magnetic fields of their own which modify the interplanetary field. These changes in the interplanetary field will be measured as the field emerges from the Moon and passes through the Apollo magnetometer as it sits on the Moon. As the Moon rotates relative to the Sun once every 28 days, the interplanetary field will pass through constantly-changing lunar cross sections.

The quantity of electric currents in the Moon, which produce changes in the interplanetary field, can then be calculated, and hence the Moon's electrical conductivity.

"It is possible that the Moon is completely nonconductive," says Principal Investigator Dr. Charles Sonett, Chief of the Space Science Division at the Ames Center. If so, the interplanetary field will not be changed by passage through the Moon.

However, the Moon, like the Earth, is almost certain to be a mixture of conductors and non-conductors, comments Dr. Palmer Dyal, coinvestigator, also of Ames.

A range of assumed compositions for the Moon can be developed from already known facts about the Moon (its mass, gravity gradients, composition of surface rocks, etc.) The very large number of conductivity profiles can then be used to calculate internal temperature and physical state.

The magnetometer is part of the Apollo 12 Lunar Surface Experiment Package to be sited near the lunar equator. It uses Ames-developed flux-gate sensors and Philco-Ford electronics.

Also a coinvestigator is Dr. Jerry Modisette of Houston Baptist College, Houston, Texas.

The instrument weighs 19 pounds, uses 3.5 watts of power, and occupies a volume 11 by 10 by 25 inches. It has some 800 integrated circuits and sends back magnetic field, temperature, voltage, and orientation information.

The magnetometer was manufactured by Philco-Ford, Palo Alto, California.

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Ames Release 69- 15
November 26, 1969

PIONEER SPACECRAFT LINEUPS ALLOW THREE BONUS EXPERIMENTS

The Sun-orbiting Pioneer spacecraft are performing three new experiments on a solar system scale.

The experiments are possible only because the extremely long lives of the Pioneers have allowed them to reach the necessary positions in space.

The Pioneer Project is managed by the National Aeronautics and Space Administration's Ames Research Center, Mountain View, California.

For the first time on November 6, two identical spacecraft, Pioneers 6 and 7, successfully measured the same solar phenomena at two widely separated points in interplanetary space, experimenters report.

The two spacecraft were on a common line with the Sun, about 17.5 million miles apart. Scientists were looking for changes in the behavior of solar wind particles due to their passage through the space between the two spacecraft.

Sampling data show similar solar wind behavior at both spacecraft. Detailed analysis will be needed to identify the small but significant differences scientists expect to find.

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In a second experiment on November 29, engineers will use the two spacecraft to perform a 150 million mile interplanetary communications experiment. A third experiment is scheduled about December 1 to measure different kinds of solar particles coming from the same events on the Sun, using Pioneers 6 and 7.

At launch, Pioneers 6 and 7 were designed for lifetimes of at least six months each, but the two spacecraft have operated a combined total of seven years and two months.

During the current experiments, Pioneer 6 is passing between the Sun and Pioneer 7. Relative to the Earth, Pioneer 7 moves in the opposite direction around the Sun from that of Pioneer 6.

In the November 6 experiment, the two spacecraft were in an area 150 million miles from the Earth, and 85 million miles from the Sun. They were observing the side of the Sun opposite the Earth.

During the second experiment on November 29, Pioneers 6 and 7, still on the other side of the Sun, will be on a common line with the Earth. This will enable NASA's Deep Space Network to rehearse for concurrent tracking of two spacecraft, needed for the Mariner 1971 and Viking 1973 missions to Mars.

On these missions, two spacecraft will be in orbit around Mars at the same time. A single 210-foot dish antenna will have to send and receive commands from these spacecraft at the same point in space at the same time.

About December 2 in the third experiment, Pioneers 6 and 7 will be on a common spiral line, leading out from the Sun.

Low energy solar wind particles leave the Sun in straight lines, but high energy solar particles spiral out following the spiral pattern of the solar magnetic field.

By December 2, Pioneer 6 will be in a position to observe solar high energy particles at one point in space. Two to three minutes later, Pioneer 7 will measure the same particles for changes due to their passage through space.

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Ames Release 70-1
January 20, 1970

MOON SOIL APPEARS YOUNGER THAN THOUGHT

The oldest Apollo 11 moon material appears to be almost a billion years younger than the 4.5 billion year age reported for it at the Lunar Science Conference in Houston, Texas, January 5-8.

Dr. William Quaide, geologist at NASA's Ames Research Center, Mountain View, California, says results of his studies of the lunar material contradict the age of 4.5 billion years reported for the lunar soil brought back from the Apollo 11 landing site on the moon's Sea of Tranquility.

Most of the thick layer of lunar soil and rocks at Tranquility Base, he says, appears to have been formed from the local volcanic bedrock underlying the Apollo 11 landing site.

These local bedrocks were dated by three methods at around 3.65 billion years old. The same dating methods were said to show the lunar dust, or soil, to be almost one billion years older, 4.5 billion years old.

However, says Dr. Quaide, when individual particles were taken from the soil and dated, they again measured at the 3.65 billion year age.

The Ames scientist reports that his discussions with the researchers who did the dating and the general discussions of dating at the Houston meeting brought

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out problems of dating lunar soil, as compared with lunar rocks, which are really coarse constituents of the soil.

Scientists doing the dating have described the age of the lunar soil as an "apparent age".

An age of 4.5 billion years for the lunar soil is difficult to sustain, says Dr. Quaide. Soil from the Apollo 11 site is known to contain a large proportion of local rocks 3.65 billion years old. There would have to be a large proportion of rocks far older than 4.5 billion years in the lunar dust to come out with an average age of 4.5 billion years (the probable age of the earth and meteorites and perhaps the moon).

This non-local material would have had to be from in-falls of meteorites or debris from other parts of the moon. The debris from elsewhere on the moon would have been blasted loose by meteorite impacts, and thrown to the Sea of Tranquility.

Neither laboratory simulations at Ames of the mechanics of meteorite action on the moon nor studies of the moon material itself confirm the presence of large amounts of such in-fallen material.

Most of the lunar soil at Tranquility base appears to have been ground up by countless meteorite impacts on the volcanic lava flows which apparently occurred there 3.65 billion years ago. Nature of these volcanic bedrocks at Tranquility Base has been determined from study of the large fragments of volcanic rocks brought back by the astronauts. These rocks are similar to one another and have probably not moved very far from their site of formation on the moon.

Furthermore, says Dr. Quaide, Ames studies, and those by other investigators of the lunar soil, show that most of it is similar in composition to the large rocks probably derived from bedrock lavas at Tranquility base. The soil does contain some materials which arrived in the form of meteors (about 1 or 2 percent). There is also material which almost certainly comes from other parts of the moon.

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However, in both cases the percentages of this material are far too low to give the lunar soil at Tranquility Base an average age a billion years older than the lunar rocks.

Dr. Quaide found that the material from Tranquility Base showed the complete range of shock damage expected from a large volume of meteorite hits over a very long time period. No other mechanism is needed to explain the lunar soil at this site, he says. Chemical analyses of glass in the lunar soil shows it has a wide range in composition, typical of impact-formed glass .

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FOR IMMEDIATE RELEASE

Ames Release no. 70-2
January 21, 1970

(NOTE to editors: This is a summary of results of the Ames lunar sample experiments. Some of this material was reported at the Lunar Science Conference in Houston, but with little interpretation.)

AMES APPOLLO 11 EXPERIMENTERS EXPLAIN
FORMATION OF LUNAR SOIL, SAY MOON
NOT HOPELESS PLACE TO FIND LIFE

Lunar soil at the landing site of Apollo 11 appears to have been formed by the grinding up of the bedrock lavas during 3.65 billion years of meteorite bombardment.

Ames scientists found no life in the Apollo 11 samples, but still feel dormant life and building blocks of life could exist on the moon.

Mineralogical studies show that the moon has been very dry, probably for billions of years. The lunar rocks have differentiated into components ranging from native iron to high-silicon-content minerals. Less oxygen was present during formation of the volcanic rocks at the Sea of Tranquility site than during the formation of most Earth rocks.

These were the main conclusions of scientists at NASA's Ames Research Center, Mountain View, California, as a result of their five Apollo 11 moon rock experiments. The scientists also discovered two new extraterrestrial minerals.

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By experimenter, the Ames results were as follows:

Lunar Soil Formed by Meteorite Impact

Dr. William Quaide, Geologist, Ames Research Center

Virtually all geologic activity following the lava flows, believed to have formed the Sea of Tranquility 3.65 billion years ago, can be explained by meteorite impact.

The soil shows the complete range of shock damage that would be expected from numerous meteorite hits over a very long time. These hits appear eventually to have ground up a fresh surface of volcanic rock into the present lunar soil.

"Now we have to find out what produced the lava flows that apparently formed the Mare," says Dr. Quaide.

The mineral grains in the lunar soil turned out to be identical to those in the basaltic bedrock lavas beneath the soil layer. Composition of these bedrock lavas has been found from study of the large volcanic rocks returned by the astronauts. These rocks are similar to one another and have probably not moved very far from their site of formation.

The smallest grains in the sample are mostly glass, the largest mainly rock fragments. Most of the glass appears to have been produced by meteorite impact melting. Chemical analysis of the glass shows it has the wide range of compositions typical of impact-formed glass.

Much of the material appears to have been repeatedly shocked. The smallest particles showed the greatest impact damage, and this is consistent with laboratory impact studies.

Half of the crystalline grains of less than 125 microns size have shock features from pressures greater than 670,000 pounds per square inch (psi), and a quarter of these grains show pressures of over 1,320,000 psi. These forces caused internal fragmentation, complete disruption of crystal structures and melting.

(more)

Measurements of the isotope Aluminum 26 suggest that time for the lunar soil to be mixed by meteorite impact to a depth of one meter is in the tens of millions of years. Aluminum 26 is produced by the bombardment of the lunar surface by cosmic ray particles.

Life on Moon Still Possible

Vance Oyama, Chief, Life Detection Systems Branch, Ames Research Center

Preliminary results indicate no life in the sample of Apollo 11 lunar surface material.

However, life may yet be found on the moon, says Mr. Oyama, the only scientist chosen to look for it.

His group so far has cultured seven of the 40 grams of lunar dust provided them. They have sought to grow organisms in 3000 petri dishes in 100 different environments. They plan a similar search for life in the Apollo 12 moon material.

Mr. Oyama is anxious to examine samples taken from well below the lunar surface, where they would have been protected from solar radiation and continuous meteoroid impacts.

If life is on the moon, he believes it arrived there aboard a meteorite or other wandering cosmic object.

"It is unlikely that life originated on the moon," he says.

The moon has too little mass to hold an atmosphere and too little water, or even water-bearing minerals, to produce the chemical evolution of life believed to have occurred on Earth.

However, the moon has undergone 4.5 billion years of cosmic bombardment. A portion of these meteorites have been carbonaceous chondrites, which also fall on Earth and contain much organic matter.

These cosmic travelers may have buried themselves in the moon, below the reach of solar radiation. They could contain dormant life forms, says Mr. Oyama.

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He speculates that the lunar dust may actually be hostile to life since no organisms appeared, not even expected Earth contaminants. (The astronauts' life support systems, for example, spray out some 30,000 Earth organisms a minute.)

Building Blocks of Life Not Found

Dr. Cyril Ponnamperuma, Chief, Chemical Evolution Branch, Ames Research Center

Scientists found very little carbon (about 150 parts per million) and no organic carbon of biological significance in the material from Tranquility Base.

There was a higher proportion of the heavy isotope, Carbon 14, than is found on Earth or in meteorites from elsewhere in the solar system, reports Dr. Ponnamperuma.

The scientists found traces of porphyrins, the basic structural molecule of chlorophyll, but these could be from the rocket exhaust.

Since carbon is the third most abundant element in the solar system, more carbon will probably be found in samples taken below the lunar surface, says Dr. Ponnamperuma. Three billion years of solar particle and meteorite bombardment probably has converted most of the surface carbon into volatile compounds, which have "blown away" in the solar wind.

Scientists found ten times more carbon at the bottom than at the top of the one-foot core sample taken at the Apollo 12 landing site.

"Some of the organic compounds which are building blocks of life probably will be found on the moon," says Dr. Ponnamperuma. "However, it now seems unlikely that this process ever proceeded very far."

Moon Seems Dry, Differentiated, and Low in Oxygen

Dr. Klaus Keil, University of New Mexico, Principal Investigator,

Drs. Theodore Bunch and Kenneth Snetsinger, Ames, Co-Investigators

The moon has been very dry probably for billions of years. Substantial differentiation of lunar material into various minerals has occurred, almost

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certainly through internal melting. Oxygen was less abundant when the moon rocks formed than at the time similar rocks were formed on Earth, report the Ames-U. of New Mexico group.

The group discovered two new extraterrestrial minerals, one a titanium-chromium oxide, which they named titano-chromite. The other is an iron-magnesium-titanium oxide (Fe, Mg) Ti_2O_5, to be named in the near future.

They concluded that meteorites have been largely vaporized by their impact on the moon and lost into space because they found only about one percent of meteoritic material in the lunar soil.

The scientists identified some 20 minerals. These ranged from native iron to complex silicates, in roughly the same categories as Earth minerals.

There was no evidence of hydrous (water-bearing) minerals either in rocks originating at Tranquility Base, or in rocks believed to have been transported there by ejection from meteorite craters elsewhere on the moon.

Since most of the rocks were 3.5 billion years old, the group inferred that the moon has been dry that long.

They found some rocks poor in silicon (one of the two principal ingredients in most continental Earth rocks), and other rocks similar to feldspar with silicon content as high as 50 percent. This proves substantial differentiation, almost certainly due to melting of the moon.

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February 4, 1970
Ames Release 70-3

CHEMICAL SYSTEM CONVERTS
BREATH AND URINE INTO FOOD

Methods of processing the principal body wastes from food (carbon dioxide and water) into palatable new food appear to have promise for long-duration space missions. The methods also may apply to food problems on Earth.

The processes, under development at NASA's Ames Research Center, Mountain View, California, turn the carbon dioxide and water vapor breathed out, and water recovered from the urine, into sugars and the sugar-like food, glycerol. Carbon dioxide and water are about 85 percent of the waste products of food eaten. The processes use only a series of chemical reactions.

Rats have done well on diets containing large amounts of both the glycerol and the sugars. College students have been well-nourished by a diet containing quantities of glycerol alone.

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It is probably feasible to feed humans a diet consisting of 85 percent sugars and glycerol with appropriate supplements of fat, protein, vitamins, and minerals, says Dr. Jacob Shapira, Ames biochemist.

Work is underway at Ames, and under a grant from Ames, at Worcester Polytechnic Institute, Massachusetts, to develop a system able to make the chemical foods under space conditions, including weightlessness. Two industrial firms also are working on the system under contract to Ames.

Such a system could reduce food deliveries to an orbiting space station. Since 50 to 100 pounds of launch vehicle are required for each pound of payload on such missions, the weight savings are of major importance.

The processes convert carbon dioxide and water (up to 90 percent of the waste products of food eaten) into formaldehyde (HCHO). The formaldehyde then is converted into a family of sugars, and into simpler substances (trioses). The sugars are purified to be eaten as sugar. The trioses are treated with hydrogen to make glycerol.

Glycerol is a simple sugar-like substance, and makes up a small percentage of normal diets. It is sometimes fed in large quantities to people with metabolic problems.

Glycerol was chosen as a very promising food after a survey of many simple nutrients. It can be produced with the lowest temperatures, the lightest equipment, the fewest side reactions, and the least energy per pound of food.

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Problems remain to be solved in purifying the sugars, which have a range of chemical structures. The edible sugars must be separated from those which have produced diarrhea and other difficulties in animals.

However, Dr. Shapira and Dr. John Billingham, Chief of the Ames Biotechnology Division, are attempting by use of enzymes to separate out pure glucose, a highly nutritious food. The scientists also plan to devise ways to convert the glucose to starch to make many food items.

The GARD Corporation, Niles, Illinois, has a contract to improve the carbon dioxide to formaldehyde process. Esso Research and Engineering, Linden, New Jersey, is working on conversion of formaldehyde to glycerol.

# # #

Note to Editors: Three black-and-white prints showing destru ction of the aircraft test section and survival of the protected section--before, during, and after--have been released by NASA Headquarters to the wire services in Washington, D. C. These prints also are available from:
Mr. Les Gaver, News Audio-Visual, NASA Headquarters, Washington, D. C. 20546. area code 202/962-1721

Note to TV Editors: A color television news film showing the fire, destruction of the unprotected aircraft section, and survival of the test section is available from: Mr. Stan Miller, NASA-Pasadena Office. area code 213/354-6486

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Ames Phone: 415/961-1111

Home Phone:
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Ames release 70-11

October 1, 1970

FIRE PROTECTION SYSTEM TESTED

The first promising fire-protection system for large passenger aircraft has been demonstrated by scientists at NASA's Ames Research Center, Mountain View, California.

The system could provide a fire-resistant protective shell, bonded to the aircraft fuselage, to completely enclose the passenger compartment. Such a shell, as shown by this test, could provide a survivable environment for the 6-10 minutes required for firemen to subdue the fuel fire and remove the occupants.

The tested system used fire-retardant paints and foams developed by the Ames Center. It is designed to protect passengers from on-the-ground fuel fires following a crash or other landing accident.

The system is in an early development stage. However, during the recent test, a 12 1/2 foot long section of a C-47 fuselage protected by the system, and sitting in a small lake of aviation fuel (5000 gallons), maintained survivable conditions in the heart of a raging 1800° F. fire.

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An identical but unprotected section of the C-47 burned up completely in two minutes, and a 1/4 inch steel bulkhead, not part of the aircraft structure, softened and folded like taffy from the intense heat. The plane's aluminum skin burned through in about 30 seconds.

Hot gases penetrated the foam-protected C-47 hull after eight minutes of fire. Subsequent examination disclosed a flaw in foam installation which is believed to have been responsible for this event.

Ames scientists Dr. John Parker, Salvatore Riccitiello, and Paul Sawko, believe the system is definitely capable of protecting passenger transport aircraft during ten minutes of maximum intensity fuel fire.

Transport aircraft fuel fires usually are brought under control in about seven minutes, experience shows.

According to Dr. Parker, several factors need to be considered before the system can be installed in operating aircraft.

The system would add weight to aircraft using it, which might amount to from one to three percent of the payload. Some system of protecting windows from fire would have to be devised.

However, a number of promising proposals have been advanced to solve these problems--such as using the strength of the foam itself in an aluminum sandwich structure to reduce aircraft weight.

The system's fire retardant paint is used on the inner skin and structural formers of the aircraft. Then fire-retardant foam is sprayed about three

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inches deep between the interior formers, creating a solid lightweight mass, bonded to the aircraft skin and structure.

In a fire, both fire-retardant paint and foam release fire-extinguishing vapors and form insulating flame-proof black char. The paint, in addition, swells into an insulating foam material and fills any spaces between joints.

The paint has a capacity to swell from 70 to 100 times its original volume when heated about 575°F, producing a foam-like closed-cell char.

The paint is a new product based on salts of nitro-substituted aromatic amines. Surveys of similar paints indicate it is the most effective such paint yet developed.

The foam, also newly-developed, is a polyisocyanurate with additives, and is believed to be one of the most effective fire-retardant foams yet devised.

During a fire, the foam retains about 50 percent of its mass in an extremely tough insulating black char.

The foam during normal aircraft operation could serve as insulating material against aircraft engine noise and aid in cabin temperature control.

# # #

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Ames Release 71-3
January 26, 1971

APOLLO 14 ASTRONAUTS TO CHART LOCAL LUNAR MAGNETIC FIELDS

AMES RESEARCH CENTER, Mountain View, Calif. --The Apollo 14 astronauts will chart local magnetic fields on the surface of the moon, in the hilly upland region of the Fra Mauro landing site, using a highly specialized portable magnetometer. The instrument was developed and built in less than six months by NASA's Ames Research Center, Mountain View, California.

The astronauts will transport the lightweight magnetometer on the two-wheeled push cart which carries all the mission's portable experiments.

Ames' Dr. Palmer Dyal proposed the portable magnetometer experiment and is the principal investigator for the Apollo 14 experiment. The instrument was built at Ames under the direction of Carle Privette, project manager.

The magnetometer consists of: a cube-shaped sensor head which measures about three inches on a side, an electronics package 7 1/2 by 5 by 4

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inches, containing three indicator dials, a tripod, and a cable reel with 50 feet of ribbon-like electrical cable. The instrument is powered by 42 tiny batteries similar to those for pacemaker devices used in the treatment of certain types of heart defects. Enough power is available for 66 hours of operation.

The device will be carried on the outside of the Lunar Module near one of the landing legs. It will be transferred to the Mobile Equipment Transporter (MET) for moving on the surface of the moon.

To use the instrument, one of the astronauts will set up the sensor head on the tripod and deploy it about 40 feet from the electronics package and indicators,which are left on the MET. He then calls out readings from three meters on the electronics package over the voice communication link to Mission Control Center at Houston. Then he rotates the cubical sensor head on the tripod to an opposite position to fine tune the sensor and its electronics. He then calls out the new indicated readings.

After repeating the process a second time to fully calibrate the the instrument in the lunar environment, he moves the tripod with the sensor to other locations. There he makes new observations as he progresses on his lunar surface excursion.

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During the Apollo 14 moonwalk, astronauts Alan Shepard and Edgar Mitchell will cover about 1.8 miles, and be a little less than .9 miles away from the lunar module at their farthest point.

Thus, the Lunar Portable Magnetometer will be used to make a rough map of the magnetic field over an extended area of the lunar surface. It will triangulate the locations of any local magnetic fields.

Ames' studies of the moon's magnetic fields have been going on since 1967 when NASA launched the Explorer 35 spacecraft, containing an Ames magnetometer, into orbit around the moon. It indicated that the moon's main magnetic field was so small as to be virtually unmeasurable from orbital heights.

Then in 1969, the Ames researchers came up with a very sophisticated, strange-looking, three-armed magnetometer instrument. The Apollo 12 astronauts deployed this one on the lunar surface. They expected to measure the weak generalized lunar field induced in the moon by the solar wind. But, when the first magnetic measurements came back from the surface of the moon, they showed a strong local field. This field apparently represented some kind of local extreme variation in the lunar magnetic characteristics relatively near the Apollo 12 magnetometer.

According to Ames' Dr. Charles Sonett, principal investigator for the Apollo 12 magnetometer experiment, the Apollo 12 findings suggest that other

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local lunar fields were frozen into lavas cooling from the molten state early in the moon's history. Lunar sample analyses by several other investigators, as well as new evidence of local fields from Explorer 35, provide additional evidence for fossil magnetic fields. These findings suggest that: the moon either once was spinning rapidly and had an internal source of magnetism much like that of the Earth, or that for a period the moon was close to the Earth, or that early in solar system history the sun had a much larger field than at present.

The portable magnetometer will permit magnetic measurements at a number of locations on a single Apollo mission. Data from this experiment, when combined with data from the Lunar Surface Magnetometer at the Apollo 12 site, and fromthe magnetometer on Explorer 35 circling the moon, are expected to substantially broaden our knowledge base of information about the moon.

# # #

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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Stan Miller

FOR RELEASE:
Thursday a.m.
August 19, 1971

Ames Release 71-31

(Also being released by
Stanford Medical Center and
NASA Headquarters, Washington, D. C.)

SPACE TECHNOLOGY TO AID CARDIOVASCULAR PROBLEMS

AMES RESEARCH CENTER, Mountain View, Calif.--A unique approach to solving significant medical problems in heart disease will be employed by a newly-formed Stanford University-National Aeronautics and Space Administration research team.

This Biomedical Technology Transfer Team (BATeam) will apply aerospace technology generated by NASA to major problems in the field of cardiology.

The team, based at Stanford's School of Medicine, is under the direction of Dr. Donald C. Harrison, Chief of the Division of Cardiology.

Under NASA contract, the project is part of NASA's Technology Utilization Program.

The Stanford group, the fourth biomedical team established throughout the country, is the first to be formed at a leading school of medicine.

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The Stanford program is also unique in that it will, for the most part, concentrate on problems in only one area--cardiovascular medicine.

Several major medical centers on the West Coast will be contacted to obtain significant problems to work on which may be solvable by NASA technology.

The team will consist of five medical consultants and two administrative staff members from the Medical School, as well as five aerospace engineering consultants.

In addition to Harrison, the medical consultants are Drs. Edwin Aldeman, William Barry, David Cannom, and Richard Crow, all from the Division of Cardiology at Stanford.

Deputy director of the program is Harry Miller, research associate and business manager of the division.

NASA currently has eight special teams charged with identifying individual problems and proposing solutions based on aerospace technology. Four of the teams concentrate on environmental problem areas. Another four, including the Stanford research team, concentrate on biomedical activities in public health, medical research, and clinical medicine.

The new program will increase the joint research efforts of Stanford and NASA-Ames Research Center. Ames, the lead NASA center in life sciences research, will be a key technology resource for the new team.

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Dr. Harrison and his staff have worked closely with Ames for the past several years, with many clinical innovations resulting. In April, a Stanford-Ames team devised a computer system to watch a movie of the beating of a patient's diseased heart--identifying dead spots or scar tissue in the heart wall, aneurysms (bubble-like projections of the heart muscle), and other malfunctions.

# # #

for release:
8/19/71

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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Larry King

Ames Release 71-32

(Also being released at
NASA Headquarters, Washington, D. C.)

FOR RELEASE:
IMMEDIATE

BREATHING OXYGEN RECLAIMED FROM WATER VAPOR

AMES RESEARCH CENTER, Mountain View, Calif.--Astronauts on future space missions may breathe oxygen reclaimed from moisture in their own breath and perspiration.

A prototype water vapor electrolysis system developed at the National Aeronautics and Space Administration's Ames Research Center has successfully completed more than 2,000 hours of testing, a period equivalent to an 80-day space mission. The new system converts moisture in the air directly into hydrogen and oxygen and releases the reclaimed oxygen back into the air.

The average person breathes about two pounds of oxygen daily, but he puts back into the air about three pounds by expiration and perspiration. The extra pound comes from water taken into the digestive system by eating and drinking.

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The Ames conversion system, when fully perfected, may mean that bulky and heavy tanks of breathing oxygen will be unnecessary on future long-duration space missions. It would have the additional advantage of reducing the load on humidity control equipment by removing excess water vapor from the cabin atmosphere.

Dr. Theodore Wydeven, research scientist at the Ames Office of Life Sciences and developer of the electrolysis unit, points out that "although the water vapor conversion system was conceived in research for future space missions, it has potential usefulness in other areas. In aviation, it might be used as an on-board oxygen system; in medicine, it might be a portable oxygen generator for hospitals and homes; and it might be a commercial air conditioner and freshener in mines and caves, air raid shelters, or any place where air might need oxygenation."

Tests indicate the system is capable of high reliability and would be suited for use in a regenerative life support system. It has only one moving part, an electric fan which pulls air across a sponge-like material which holds an acid electrolyte. The acid absorbs moisture from the air, and when electric current is passed through it, the water in the acid solution is electrolyzed or broken down into its basic components. Oxygen is liberated on one side of the cell, hydrogen on the other. A microporous membrane prevents intermixing of the two gases.

(more)

In a spacecraft cabin application, the oxygen would be put into the cabin airstream for breathing, and the hydrogen either used for spacecraft systems or jettisoned into space.

Dr. Wydeven's unit used in the basic development program produces enough oxygen to sustain one man. It measures about 15 inches square and 27 inches deep. Another package, approximately the same size, contains the power supply and electronic controls. Dr. Wydeven believes a flight weight unit could be built which would weigh about 35 pounds and take up 1.3 cubic feet of space, including the control and power supply system.

# # #

8/17/71

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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FOR IMMEDIATE RELEASE

Ames Release 71-47

(Also being released by NASA Headquarters, Washington, D. C.)

FLYING SIMULATOR TO TEST FUTURE AIRCRAFT CONCEPTS

AMES RESEARCH CENTER, Mountain View, Calif. --The Ames Research Center has completed acceptance tests on a vertical take-off and landing (VTOL) aircraft which can duplicate, or simulate, the hovering flight characteristics of most existing and proposed VTOLs.

The new National Aeronautics and Space Administration research aircraft, the X-14B, is a major modification of a veteran NASA-Ames VTOL research aircraft, the Bell X-14A.

The X-14B is believed to be the first digital-computer-driven VTOL flight simulator aircraft yet developed. It promises to be an important tool in VTOL aircraft research.

Aircraft designers use simulators, both flight and ground-based, to find in advance the handling or piloting qualities of proposed new aircraft. Handling qualities "what it will be like to fly", are basic design limitations for any new aircraft. The conversion to flying flight simulator was performed by the Northrop Corporation, Hawthorne, California, under a $1.2 million contract.

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The plane carries a small general-purpose, aircraft-type digital computer with a capacity of 16,000 16-bit data words. Into the computer are programmed the flight characteristics of the VTOL aircraft to be simulated. When researchers wish to convert flight characteristics of the X-14B to those of another aircraft, they simply put in a new computer tape.

A major part of the research planned with the plane will be to determine optimum handling qualities for any VTOL. Piloting a VTOL has been described as "like balancing on top of a huge beach ball in a rough sea." Hence handling qualities of these aircraft are critical.

"Because the X-14B can produce virtually all pilot-handling qualities, we hope to come up with the ideal combination of these piloting qualities for any VTOL," says Frank Pauli, X-14B project engineer.

The Ames researchers plan to use the X-14B to study several control systems previously developed in ground-based simulation. Future plans call for use of the airborne computer to simulate advanced systems designed to allow the pilot a choice of handling characteristics. Different characteristics would be selected depending on whether the pilot is in hovering flight, or in the transition from vertical to horizontal flight. This idea can be extended further to systems that automatically select the best piloting characteristics for each type of flight.

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Flight simulator aircraft extend the results of ground-based flight simulators. These ground-based devices are motion-generating machines which are "flown" down on the ground by research pilots. They are programmed by computer to duplicate the flight maneuvers of a wide range of aircraft. Designers use them to study piloting qualities of new aircraft in the early concept stage. Test maneuvers can be "flown" on the ground in a large building without hazard to pilots, and information can be gained far more cheaply than by building a prototype aircraft to test each proposed design. However, still further realism can often be obtained by flight simulator aircraft.

Like a ground-based simulator, the X-14B can duplicate the flight maneuvers of a wide range of aircraft. Since it can fly, its movements are not artifically restricted, and it can more realistically duplicate the piloting qualities of new airplanes.

# # #

9/22/71

NEWS
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FOR RELEASE:
upon receipt

Ames release 71-71

EARLY SOLAR SYSTEM HISTORY

TRACED BY AMES SCIENTISTS

AMES RESEARCH CENTER, Mountain View, Calif. --Researchers have found evidence for a series of cataclysmic occurrences during the early history of the solar system which may have shaped today's Sun and planets.

Scientists at NASA's Ames Research Center, Mountain View, California, propose that during a period some 4.6 billion years ago, the Sun may have been spinning 200 times faster than it is today. This spin rate would have been one solar rotation every three hours, instead of the present one rotation every 27 days.

The high rotation rate and other mechanisms typical of newly-formed suns are believed to have forced a huge flow of electrified gases out from the Sun--causing it to lose an estimated one third of its original mass in only a few million years. This outflow of gases would have stripped away the primordial atmospheres of the inner planets: Mercury, the Earth, and Mars. The flow of electrified gases could have completely melted Mercury and portions of the

(continued)

Moon. Complete melting almost certainly could have occurred in small bodies with diameters of about 100 miles or less, such as most of the asteroids.

The melting would have resulted from heating by electrical induction on an enormous scale. The flow of electrified gases would have carried the solar magnetic field along with it out from the Sun. The field would have rotated rapidly with the Sun, and passed continuously through the planets and asteroids.

This would have been like a gigantic electric generator running for a million years. As currents flowed through the planets, electrical resistance would have produced continuous heating by the same process that causes an electric stove element to heat.

Evidence for these early solar system events comes from melting histories of meteorites recovered on Earth, and from a class of very young stars, known as T-Tauri stars, according to Dr. Charles P. Sonett, who heads the Ames group working on the problem. Other researchers in the group were Dr. David S. Colburn, of Ames, and Dr. Kenneth Schwartz, of American Nucleonics Corporation, Woodland Hills, California.

Many scientists agree that the interstellar gas cloud which produced the solar system probably formed about five billion years ago. By about 4.6 billion years ago, gravity is believed to have compressed the cloud tightly enough to form the primordial earth, the early Sun, and the other planets--as well as the asteroids, the belt of rock fragments circling the Sun between the orbits of Mars and Jupiter.

The first indications of an early high-spin Sun came from meteorites.

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Tracking of incoming meteor trajectories has established that most meteorites probably originate in the Asteroid Belt. Radioactive dating has established that many meteorites were melted at a time consistent with the high-spin theory, about 4.6 billion years ago. Extensive mineralogical studies show some histories of complete melting, with cases of iron and nickel smelted out into a nearly pure state. The same studies suggest that some of these meteorites were melted while part of larger planetary parent bodies probably in the asteroid belt. These bodies would have had diameters of 100 miles or less.

A key point is that other meteorites have no melting history at all and appear to be made of rock produced by gravitational collapse of the original solar system gas and dust cloud. However, difficulties with this concept are raised by distribution of isotopes in today's solar system, and by other factors.

These difficulties led the Ames team to examine the T-Tauri stars. These stars are rapidly losing mass, are shrouded in clouds of gas and dust, and are thought by some scientists to be examples of the early development of stars.

The Ames scientists suggest that the Sun was a T-Tauri star 4.6 billion years ago before it began following the main sequence of development usual for stars.

Virtually all newly-formed stars are believed to have relatively high rates of rotation, derived from rotation of the interstellar clouds which created them. The original solar gas cloud had perhaps fifty million times the momentum needed to cause the high-speed rotation proposed for the early Sun. An abundance of energy was available to satisfy the theory, even though part of it went into forming the planets.

(more)

The electric currents in planetary bodies could have been either internal ring currents, or currents flowing from the bodies into the surrounding electrified solar gas.

Clouds of dust like those around T-Tauri stars would have retained the early Sun's heat, and thus heated up the planetary bodies to improve their electrical conductivity.

If the Sun rotated every three hours, 4.6 billion years ago, why isn't it doing the same thing today?

The Ames researchers believe it has gradually slowed due to magnetic braking. The gas molecules thrown out by the Sun are tied to the Sun by the solar magnetic field. The inertia of this material together with the interplanetary magnetic field would have slowed the Sun over 4.6 billion years.

# # #

12/14/71

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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FOR RELEASE:

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Ames release 72-4

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AIRBORNE EXPEDITION TO STUDY CLOUDS

AMES RESEARCH CENTER, Mountain View, Calif. --Scientists are probing high-altitude cloud formations from a National Aeronautics and Space Administration Convair 990 aircraft to attempt to solve a meteorological problem applicable to short-term weather forecasting and to transfer the technology, if successful, to weather satellites.

They are looking at sunlight-scattering cloud particles at various altitudes, up to 45,000 feet, to see if ice and water particles can be identified and if the size and number of water droplets in a cloud can be measured via remote sensing instrumentation.

These measurements will be correlated on the aircraft with measurements made directly within the clouds to give a precise picture of cloud composition and particle sizes. Such information relates to the intensity of weather fronts, storms and the nature of severe weather processes. Up to now, this type of information has not been available from remote sensing techniques.

These data, when obtained globally from satellites, would be valuable to pilots, aviation meteorologists and weather forecasters who need all available

(more)

information on severe weather systems.

A team of scientists from NASA, the University of Arizona, and the Arthur D. Little Co., headed by Dr. Warren Hovis of the NASA-Goddard Space Flight Center, uses three basic experiments for the project. The first uses a filter wedge spectrometer and a near-infrared Ebert spectrometer to measure solar energy reflected from clouds. The reflective properties of clouds vary and can be analyzed to determine their physical characteristics and altitude. The second experiment uses an infrared polarimeter to study how clouds reflect polarized light and the extent to which the reflectivity shows the cloud's composition and height. The third experiment is a nephelometer which uses a laser beam to make direct measurements of cloud particle size, concentration and distribution while the aircraft flies through a cloud.

The airborne scientific expedition over the northwestern United States and the Caribbean Sea is being made by NASA's Ames Research Center, Mountain View, California, with its Convair 990 observatory, the "Galileo".

Flights over the Pacific Northwest were completed in mid-January. The second part of the expedition, covering highly active cloud formations in the Caribbean Sea, will be based at Piarco Airport, Trinidad, and Tobago.

A total of five daylight data-gathering flights are scheduled in the Trinidad area. Three are from Trinidad and the others will be made on the arrival and departure flights. The schedule calls for arrival in Trinidad on January 21, data flights on the 24th, 25th and 27th, and departure on January 29.

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The flight crew and expedition personnel total about 25 persons. Earl V. Petersen, research scientist with the Ames Research Center Airborne Science Office, is manager of the expedition. The aircraft commander is Fred J. Drinkwater, III, of the Ames Flight Operations Branch, assisted by research pilot Don Mallick of the NASA-Flight Research Center, Edwards, California.

The expedition scientist is Dr. Hovis who is also manager of the Goddard spectrometer experiment. Dr. David L. Coffeen of the University of Arizona's Lunar and Planetary Laboratory is the experimenter for the polarimeter measurements, and Robert T. Ryan of the Arthur D. Little Co. is handling the laser nephelometer experiment.

Program management of the expedition is under the overall direction of the Office of Applications at NASA Headquarters, Washington, D. C.

# # #

1/19/72

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Ames Research Center
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FOR RELEASE:

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Ames Release 72-16

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NASA TO AID CALIFORNIA
WITH RESOURCES SURVEYS

AMES RESEARCH CENTER, Mountain View, Calif. - - California Lt. Governor Ed Reinecke today reported progress in the application of NASA-developed technology to the management of California's environment, subject of a series of meetings this week at the NASA Ames Research Center in Mountain View.

The Ames sessions are the second in a two part series of symposiums held in a cooperative effort by the State of California, the National Aeronautics and Space Administration, and the University of California to identify environmental problems and examine possibilities of solving them through the use of aeronautics and space technology.

Governor Ronald Reagan has said new technology is vital to the State's role in management of California resources and recently designated Lt. Gov. Reinecke as his chief aide in developing the use of new technology for solution of state problems.

(more)

3/14/72

Ed. Note: Copy also released at NASA Headquarters, Washington, D. C. and at Office of Lt. Governor, Sacramento.

This week's meetings are reviewing NASA projects using remote sensing instruments, including cameras, which can sense conditions on Earth from high in the atmosphere or from space.

"These projects include using special techniques to monitor the production of chlorophyll in fresh and salt water, the extent and kinds of oil slicks on water surfaces, sedimentation in Lake Tahoe, and all forms of air pollution," said Reinecke.

Meetings at the University of California's Space Science Laboratory at Berkeley last week concentrated on new applications and methods of interpreting photographic data from NASA's Earth Resources Technology Satellite (ERTS) and from high altitude Earth survey aircraft, with special emphasis on agriculture and forestry.

The series will conclude with the definition of some California problems in the fields of water quality, land use, urban planning, public health, geology and air quality, where remote sensing technology can assist in finding solutions.

A. Earl Davis, Remote Sensing Coordinator for the State of California, Sacramento, is in charge of arrangements for the meetings. Dr. Robert N. Colwell heads the University of California Space Science Laboratory sponsoring the first sessions. The Ames Research Center's Earth Science Applications Office, under Leo Poppoff, is co-sponsor of the workshop and host for the final session this week.

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State agencies involved in the development of technology transfer from space and aeronautics to state problems include: Resources Agency under Norman Livermore, Jr.; Agriculture and Services Agency under J. Earl Coke; Human Resources Agency under James Hall; and the Business and Transportation Agency under Frank Walton.

Organizational representatives from these agencies are the Air Resources Board, Department of Conservation Division of Mines and Geology, Department of Navigation and Ocean Development, Department of Public Health, Department of Parks and Recreation, Water Resources Control Board, Department of Agriculture, Department of Water Resources, State Lands Division, and the Department of Public Works Division of Highways.

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FOR RELEASE:
Tuesday, March 21, 1972

Ames Release 72-20

(also being released by NASA Headquarters, Washington, D. C.)

ELECTRON MICROSCOPY--

THREE TIMES BETTER

AMES RESEARCH CENTER, Mountain View, Calif. --Microscopic details of truly atomic dimensions are now clearly visible under a transmission electron microscope because of an innovation developed in aeronautics and space research.

Two NASA physicists at the Ames Research Center, Moffett Field, California, who are trying to determine how free atoms and molecules interact with surfaces of various materials, found they could see more--in fact, about three times better--because of the highly improved resolution and contrast they obtained by altering the structure of the illuminating and image-producing electron beam in their microscope.

Doctors Helmut Poppa and Klaus Heinemann can now--through a simple aperture method they devised--distinguish distances of about one Angstrom as compared to resolutions of about three Angstroms which normally can be obtained with the better, present day, standard electron microscopes.

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3/17/72

To give the layman some idea of how truly microscopic this is, conversion tables give the length unit Angstrom as .000000004 of an inch (.00000001 Centimeter), dimensions inconceivably small to the non-scientist.

Because this breakthrough gives scientists much better resolution of microscopic details than the best present standard electron microscopes, it is expected to be an extremely significant and helpful development to researchers who use electron microscopy in such fields as biology, medicine, biophysics, metallurgy, geophysics, and electronics.

It is expected to be especially effective in medical research where the electron microscope is widely used and where researchers are particularly interested in obtaining better contrast as well as increased resolution. Cancer researchers, comparing the NASA technique with several standard methods, found they obtained the best results with the NASA techniques.

Drs. Poppa and Heinemann have been able to observe important structural details in electronic and metallurgical materials which had never been seen before. They did their work in the Materials Research Branch of the Astronautics Directorate at Ames, where Poppa is employed. Heinemann is an employee of Stanford University working under a NASA grant at Ames.

NASA is seeking a patent for the innovation which its inventors call an "Annular Aperture System." The patent will be available for commercial licensing. The special aperture can be installed in any reasonably good electron microscope.

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Present microscopes illuminate the specimen being examined with a normal beam of electrons. The microscopes equipped with the new annular aperture system use an illuminating beam that is "shaped" so that it hits the specimen obliquely (surrounding the specimen from 360 degrees in a cone-like formation) and limits the imaging part of the electron beam to an annular zone in the objective lens of the microscope. Hence, Poppa and Heinemann refer to their technique as "Conical Specimen Illumination" and "Selected Zone Dark Field Microscopy", respectively.

The net effect of this method is to drastically reduce chromatic aberration (lens error) of the microscope's optical system and radically improve resolution and contrast, thus exposing more detail and giving the view a more informative image of the specimen.

# # #

NEWS

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FOR RELEASE:
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Ames Release 72-22

NASA TEAM ON ARCTIC STUDY

AMES RESEARCH CENTER, Mountain View, Calif. --New instruments developed for advanced satellites will be used this month to aid a team of scientists studying the behavior of ice floes deep within the Arctic Circle.

While scientists afloat on ice islands are gathering information as part of the Arctice Ice Dynamics Joint Experiment (AIDJEX), radiometers looking down from NASA's Convair 990 jet aircraft will sense sea ice temperatures over the area, chart ice floe movements, and record other physical data to help study the interaction between the atmosphere, pack ice, and ocean currents.

The AIDJEX project, with the National Science Foundation as the lead agency for the United States, hopes to advance solutions of theoretical and practical problems which range from the extent of Arctic ice cover and its influence on global ocean circulation to the passage of ships through ice-covered seas. Scientists from the United States, Canada, and Japan form the AIDJEX team.

The NASA Convair 990, a flying laboratory operated by the Ames Research Center, Mountain View, California, will carry microwave radiometers which have been devised by scientists at the NASA-Goddard Space Flight Center,

(more)

3/31/72

Greenbelt, Maryland, for later use on Nimbus spacecraft, a series of advanced weather monitoring satellites. In addition, an infrared imager, infrared radiometers, and a laser geodolite will be used.

The aircraft will operate out of the Fairbanks, Alaska, International Airport and Eielson Air Force Base near Fairbanks beginning April 3. The flights extend through April 20 and will cover a circular area northeast of Pt. Barrow, Alaska, between 70 and 80 degrees north latitude.

# # #

NEWS

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FOR RELEASE:

Monday, May 22, 1972

Ames Release 72-34

(Also being released by NASA Headquarters, Washington, D. C.)

ANTI-SYMMETRY FOR SUPERSONIC FLIGHT

AMES RESEARCH CENTER, Mountain View, Calif.--A radical change in the basic geometry of an aircraft wing might, according to preliminary NASA theoretical and test predictions, allow future jet transports to operate quietly and efficiently at both take-off and supersonic speeds.

Dr. R. T. Jones of the National Aeronautics and Space Administration's Ames Research Center is suggesting that an anti-symmetrical wing, pivoting on its center point, may be the way to achieve supersonic transport capability without the penalties of high fuel consumption and noise associated with conventional SST aircraft in production.

"Man has an instinctive feeling for bilateral symmetry," Dr. Jones remarks, "which is no doubt derived from seeing naturally evolved birds and animals. It is natural for us to mold the shape of a supersonic aircraft to suit this instinctive feeling. However, nature does not provide us with a guide for supersonic flight; there are no supersonic birds.

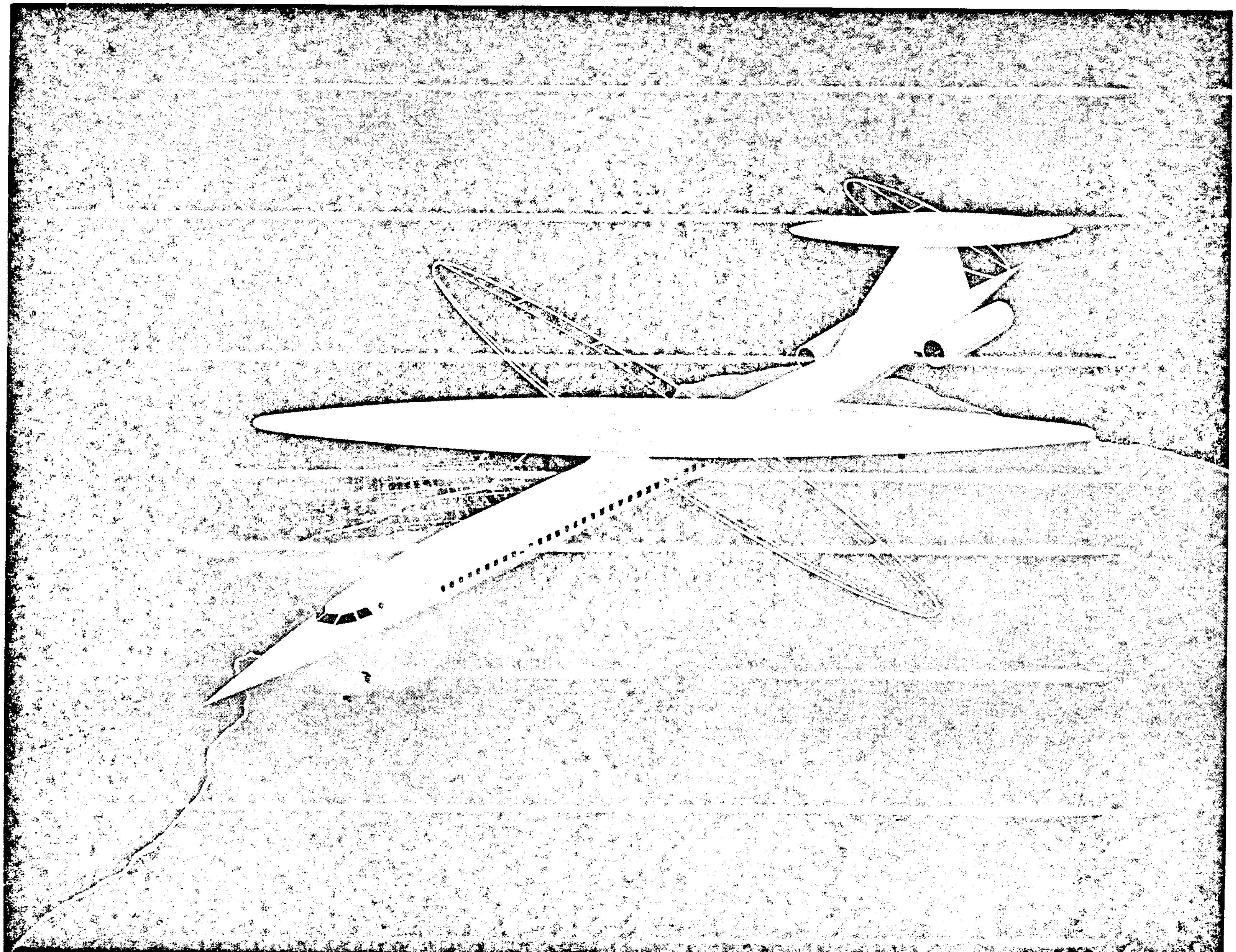
"It is interesting, and probably important, that mathematical theory indicates a completely different kind of symmetry for supersonic aircraft."

Now a senior staff scientist with Ames, Jones is credited with the development in 1945 of swept-wing theories which were instrumental in advancing aircraft speeds into the transonic and supersonic ranges. Most jet transports now in use are based on his aerodynamic theories and on his work with slender delta wings.

The new design would appear to have a conventional straight wing at right angles to the fuselage during take-off on medium length runways such as Washington (D. C.) National Airport. An aircraft in this configuration would require only about one-fourth the take-off energy now needed by comparable delta wing jet transports with similar payloads. As the conceptual aircraft reaches the speed and altitude where swept wings would be efficient, the entire wing would rotate about 45 degrees so the wing on one side would point more in the direction of flight and the other half would trail toward the rear. Studies indicate that cruising in this configuration at supersonic speeds up to about Mach 1.2 would not produce a sonic boom on the ground and could be accomplished with nearly the same fuel economy per passenger mile as current jet aircraft at subsonic speeds. Over ocean areas where sonic effects are not detrimental, the conceptual aircraft could cruise up to Mach 1.5.

If current testing, computational prediction and further research verifies the promise of the new design, the anti-symmetrical wing concept would open the door to development of a more commercially efficient, ecologically acceptable jet transport for the nation's future needs. In an in-house effort, the Ames Research Center is continuing theoretical computer studies and wind tunnel studies using models "flown" at speeds up to Mach 1.4.

# # #



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June 23, 1972

Ames Release 72-46

NASA APPOINTS NEW AERODYNAMICS DIRECTOR

AMES RESEARCH CENTER, Mountain View, Calif. -- The appointment of J. Lloyd Jones, Jr., 2345 Byron St., Palo Alto, as NASA's Director of Aerodynamics and Vehicle Systems in Washington D. C. has been announced by Ames Research Center director Dr. Hans Mark.

Mr. Jones, who has been the center director's research assistant since 1970, will assume his new duties in the National Aeronautics and Space Administration's Office of Aeronautics and Space Technology under Roy P. Jackson, Associate Administrator. He will head research efforts at four NASA research centers in advanced aeronautics.

Mr. Jones' 28 year career with the Government at Ames Research Center, has included service with the National Advisory Committee for Aeronautics, NASA's predecessor, and NASA. During his carrer he has worked with advanced aeronautical research facilities accomplishing basic and applied research on a variety of programs including the lifting body program which has furnished important technology for the Space Shuttle effort.

He is a member of several NASA technical committees on aeronautics, and was the chairman in 1965 of the San Francisco Section of the American Institute for Aeronautics and Astronautics.

He is a graduate of the University of Washington, 1944, and earned a masters degree in engineering science from Stanford University in 1952.

- more -

Mr. Jones, and his wife Kathleen, will move to the Washington D. C. area this summer. They have three children, Janet, Susan and Stephen.

# # #

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IMMEDIATE

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Release 72-55

NASA AIRCRAFT IN FIRE EFFORT

AMES RESEARCH CENTER, Mountain View, Calif.--- High altitude photographs of the Molera fire in the Big Sur area which were taken from a NASA aircraft are being used to plan strategy for fighting the disastrous fire.

NASA is scheduling picture sorties of its Earth Resources Survey Aircraft at the request of State of California fire officials who are evaluating the use of High Altitude photography in fire fighting.

Pictures of the 3,800 acre fire are being made in both black and white and infrared color. The infrared pictures are particularly valuable because the contrast between the burned and unburned areas shows up clearly for quick delineation of the fire perimeter. Black and white prints can be given to individual fire crews for use in guiding them along the proposed fire line.

First pictures were taken Wednesday afternoon (August 2) from altititudes of 65,000, 45,000 and 25,000 feet. They were delivered to officials from the State Division of Forestry and the US Forest Service Wednesday evening and were used in planning Thursday fire fighting activities.

Future flights will be made at 47,000 feet and 26,000 feet. At these altitudes the pictures correspond exactly to scales of maps used by fire fighters.

-end-

8/3/72

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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FOR RELEASE:
IMMEDIATE
September 7, 1972

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Release 72-66
This information has been released by NASA Headquarters.

GIANT SOLAR STORM CREATED UNIQUE INTERPLANETARY EXPERIMENT

AMES RESEARCH CENTER, Mountain View, Calif.--- The series of Earth-sized explosions on the Sun during August created the most intense solar storm ever measured, and is providing new knowledge of the Sun and the solar atmosphere.

Scientists with experiments aboard two interplanetary spacecraft, Pioneers 9 and 10, say they made measurements which "are absolutely unique." Their quick-look data shows that the solar wind, the continuous flow of ionized gases out from the Sun, did not behave as expected as it moved outward 213 million kilometers (132 million miles) between the two spacecraft. Instead it converted its motion energy into thermal energy; the gases lost half their speed but increased in temperature dramatically.

Since the only star man can study at close range is the Sun, the data should help in understanding all Sun-like stars.

During the peak of the storm on August 2, the two spacecraft happened to be on a direct radial line straight out from the Sun. Pioneer 9 was 116 million kilometers (72 million miles) from the Sun, 34 million kilometers (21 million miles) inside the Earth's orbit. Pioneer 10, a third

- more -

of the way on its trip to Jupiter, was 213 million kilometers (132 million miles) farther out than Pioneer 9, 328 million kilometers (204 million miles) from the Sun.

The radial line-up of Pioneers 9 and 10 had been planned as an important opportunity to measure the same masses of solar wind gases in two widely separated places in a quiet state. The storms were a tremendous bonus for this experiment.

During the storms Pioneer 9 saw the highest solar wind speeds ever recorded, and Pioneers 6 and 9 the greatest numbers of high energy particles ever seen in space.

"We expect other unusual findings from further comparisons of particle and magnetic field measurements by these two spacecraft, one near and one far from the Sun," commented John Wolfe, Pioneer Project Scientist.

The five interplanetary Pioneer spacecraft, managed by NASA's Ames Research Center, Mountain View, Calif., operate outside the Earth's magnetic envelope (the magnetosphere). Hence they see solar phenomena unaffected by the Earth. Their observations of this month's storms will be augmented by those of Earth satellites and ground stations.

Known as region 331, the huge solar surface area produced three enormous explosions on August 2, and another solar cataclysm on August 7. This second event produced, during a one-hour period, energy equal to U.S. electrical power consumption for 100 million years at present rates.

Storm effects in Canada, the norther U.S., Sweden, and Alaska were major due to violent warping of the Earth's magnetic field, which caused power and communications blackouts and other magnetic phenomena.

- more -

Although region 331 has now rotated around to the Sun's invisible side, space measurements indicate it is still spouting particles, and x-rays in massive amounts. The region will continue to be observed by Pioneers 6, 7, and 8, which are spotted around the Sun.

Solar wind speeds of more than 3,598,000 kilometers per hour (2,235,000 miles per hour) on August 3, at Pioneer 9 were the highest ever recorded. In crossing the 213 million kilometer to Pioneer 10 in 76 hours, the same solar wind gases had slowed to about one half this velocity.

Apparently particle motion straight out from the Sun had been converted to thermal motion (expansion in all directions) of the total mass of high-speed solar gas. Out at Pioneer 10, temperatures were at levels found in the solar corona of 2,000,000°K, compared with levels of normal 100,000°K.

"Exactly what all this means will have to wait further analysis," said Dr. Wolfe.

At the peak of the storm, high energy particles (solar cosmic rays) covered the 116 million km from the Sun to Pioneer 9 in under an hour, compared with 33 hours for the "slower" solar wind particles. The interplanetary magnetic field at Pioneer 10 was 100 times higher than normal.

Pioneer 9's high energy particle counters overflowed even though they were in a special counting range for solar flare periods. They saw 4000 times more particles than normal. Again on the 7th, Pioneer 6, 60 degrees father around the Sun, counted the greatest number of particles ever seen, in a different set of energy ranges, also from region 331.

-more-

Quick-look data analysis on the high energy particle experiments is not yet possible. However, "effects will probably be very large because many of these effects increase as the square of the distance from the Sun," comments Dr. Frank P. McDonald, high energy particle experimenter on Pioneer 10.

Over an outward distance of 213 million km, particle densities and energy spectra "really might be dramatically different," he said.

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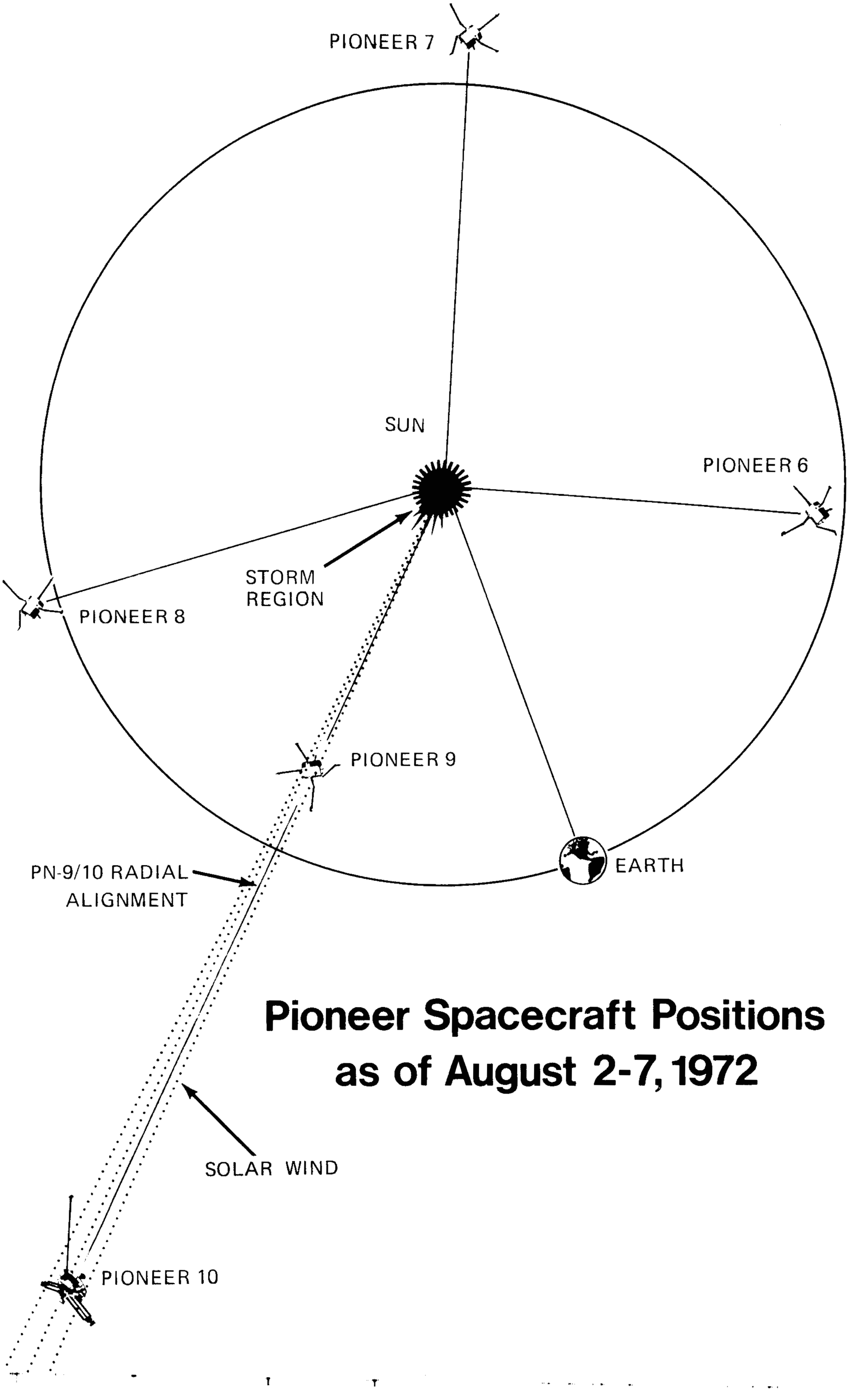

Pioneer Spacecraft Positions as of August 2-7, 1972

NEWS

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Release 72-98

AMES WIND TUNNELS

Agression against European nations in the pre-World War II era threatened a second world war. The situation demanded new and improved aircraft research facilities in the U.S. and thus in 1940, the National Advisory Committee for Aeronautic's Ames Research Center was established in Mountain View, Califorina.

Originally built to augment wind tunnel facilities at the NACA Langley Field facility, Ames Research Center is now part of the National Aeronautics and Space Administration and has the biggest, the fastest, and the most unique combination of wind tunnels of any known place in the world.

The largest tunnel has a test chamber of 12x24 meters (40x80 feet), is .8 kilometer (.5 mile) in total length, holds 815 meteric tons (900 tons) of air, and circulates it at a maximum rate of 36 meteric tons (40 tons) per second. The fastest tunnel can develop test velocities of up to Mach 50 (50 times the speed of sound) by means of hydrogen explosions. And Ames' 21 tunnels make it a more varied collection than any similar facility.

The tunnels at Ames are used to test all kinds of aircraft from helicopters to models of the new Space Shuttle vehicle. Almost all commercial airplane models from the early DC-4 to the modern 747 have been tested in an Ames wind tunnel, as well as numerous experimental aircraft such as V/STOL (Vertical/Short Take-Off and Landing).

(more)

September 25, 1972

Great savings in money and oftentimes human life are achieved by perfecting aircraft in wind tunnels. Aeronautical research engineer, Tony Cook, says that finding a significant flaw in an aircraft test could save enough money to pay for an entire wind tunnel. Of course a wind tunnel is priceless when it detects a fault that could take a test pilot's life.

A maximum power input of about 240 million watts, about enough to run the entire city of San Jose, may be used for wind tunnel operations at Ames, while all other facilities at this center combined use no more than 10 million watts.

The electric power, already owned by the government, is obtained through Pacific Gas and Electric Company, whose transmission lines supply Ames from government owned and operated power plants.

For reasons of economy, three of the wind tunnels use a common drive system. One of these, an 3 m (11 foot) "transonic," which operates from Mach .5 to 1.2, is being "sound proofed" to minimize noise which, under certain weather conditions, may be detected in surrounding communities.

The tunnels at Ames are of two structural types: the "Prandtl," or conventional air recycling type, and the "flow-through," or straight nonrecycling type.

Conventional tunnels at Ames range in size from the 12x24 m (40x80 ft.), already mentioned, to the smallest, a .6x.6 m (2x2 ft) "hypersonic," which functions at well over the speed of sound. The size of a wind tunnel is always noted in terms of its chamber dimensions with faster tunnels generally being smaller.

Since 90 percent of a tunnel's power is used in overcoming air friction against its walls, the tunnels are developed so that air flows quickly through the test chamber only. This is done by a "venturi" which funnels air into the constricted test chamber thus "squeezing" it to a greater velocity, then letting it slow itself in a wider chamber afterwards.

(more)

Conventional tunnels operate with speeds ranging from the subsonic level to well over the speed of sound. They are not nearly as fast as flowthrough models though, which work by hydrogen explosions at both ends, or by a pressure vessel which shoots air from one end. Velocities reach Mach 24 in the former, and Mach 50 in the latter.

Open end pressure vessel tunnels range in size from .3x.9 m (1x3 ft.), to 1x1 m (3.5x3.5 ft.) to a 106 centimeter (42 inch) "shock" tunnel.

Other flowthrough tunnels are "hyper-velocity ballistic free-flight ranges," in which test velocities are doubled by accelerating the test objects into an oncoming wind. These tunnels, composed of large bore gun barrels linked end to end, are housed in bunkers, and employ the double explosion.

Results of tests in these tunnels are meticulously recorded with high speed camera equipment. Conventional tunnels record data on film also, by rely more on electronic measuring equipment.

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EARTH RESOURCES AIRCRAFT PROJECT (ERAP)

-Background Information-

The acquisition of two high altitude Earth Resources Survey Aircraft by the National Aeronautics and Space Administration's Ames Research Center to expand its airborne research program was announced on April 2, 1971.

The Airborne Science Office in the Ames Astronautics Directorate manages the project and is conducting flight operations for the NASA Headquarters Office of Applications. Checkout and equipment test flights began shortly after arrival of the aircraft at Ames and data collection to support the Earth Resources Technology Satellite (ERTS) program began in August 1971.

Sustained flight at 20,014 meters (65,000 ft.) has demonstrated that the aircraft is an ideal platform for remote sensing of Earth resources data.

The objectives of the Ames Earth Resources Aircraft Project are:

- to collect data over various test sites simultaneously with passes of the ERTS satellite and Skylab after they are in orbit.

- to support general Earth resources programs in conjunction with other government agencies.

- to conduct observations in astronomy, high altitude atmospheric physics and geophysics.

- to collect data for disaster assessment.

(more)

September 26, 1972

From August 1971 to March 1972, the project's primary assignment was to obtain data simulating that to be provided by the ERTS satellite for use by government, university and industry scientists connected with the ERTS program. For this purpose, five ecological test areas averaging 28,757 square miles each were photographed on repetitive flights at approximate intervals of 18 days. This timing simulated the interval of satellite coverage. Three of these test sites were in California, one in Arizona, and one (the Chesapeake Bay region) on the east coast.

April through June 1972 the Project provided satellite simulation data over a variety of U.S. test sites for specific ERTS program investigators who had critical seasonal requirements for data. Since the ERTS-A satellite was not launched until July, these investigators would have been lacking important coverage of their test sites.

Beginning in late June and continuing for the life of the ERTS-A satellite (anticipated one year) the Project is providing underflight support data to over 50 ERTS program investigators from various test sites in the western and eastern U.S. High altitude ERTS underflight support data for the central U.S. is provided by NASA Manned Spacecraft Center, Houston, Texas with their sensor-equipped high altitude RB-57F.

Other current tasks of the Ames ERAP project include the following:

- collecting photographic data over the entire state of Arizona as part of a three-way agreement between NASA, the Department of the Interior and the state of Arizona in a project entitled Arizona Land Use Experiment.

- earth resource surveys for various governmental agencies.

- disaster assessment flights--such as those for forest fires and floods.

(more)

September 26, 1972

Future tasks of the project will include underflight support for the ERTS-B satellite and the Earth Resources Experiment Package (EREP) of the Skylab program.

A number of camera sensor systems have been and are being developed for the Earth Resources Survey aircraft representing a highly versatile data collection capability. One of the most commonly used systems at present consists of five individual cameras. Four are matched 70 mm format cameras with 45 mm focal lengths coupled to provide simultaneous images in discrete portions of the photographic spectrum similar to those images collected by the ERTS satellite. Each matched set of 70 mm images covers approximately 242 square miles. The fifth camera of this system is a high quality mapping camera with a 6 inch focal length which uses a 9 1/2 inch wide film. Each image from this camera covers an area of approximately 341 square miles. This camera is generally used with color infrared film which has proven to have considerable utility for various earth resource observations.

The Earth Resources Survey Aircraft based at Ames Research Center are designated Earth Resources Survey Aircraft numbers 4 and 5. For data flights over the eastern U.S., they are staged from NASA's Wallops Island Station in Virginia. Base of operations for flights in the western U.S. is at Ames.

Maximum flying hours for each aircraft is about 50 hours per month, including both data collection and various checkout flights.

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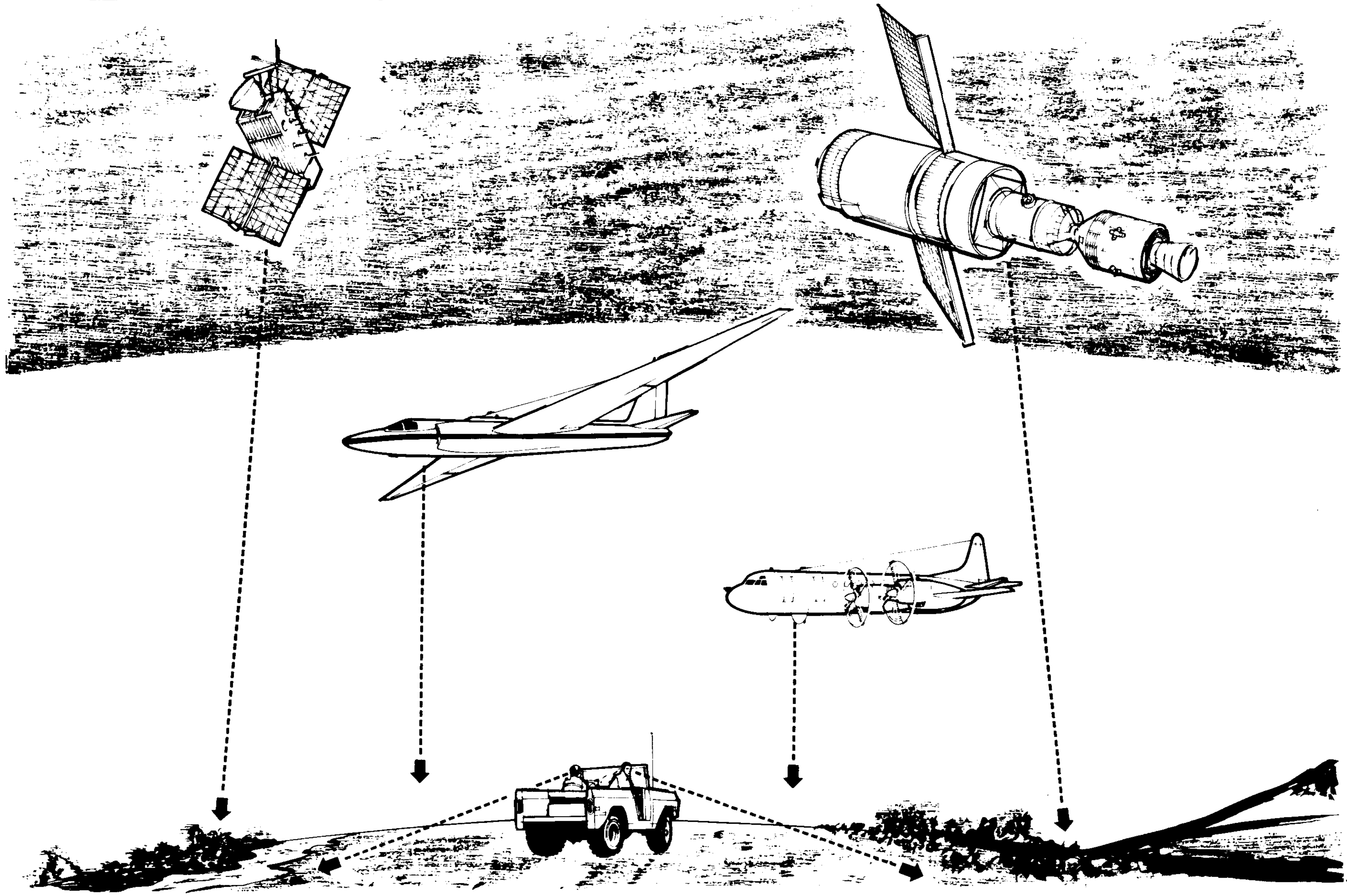
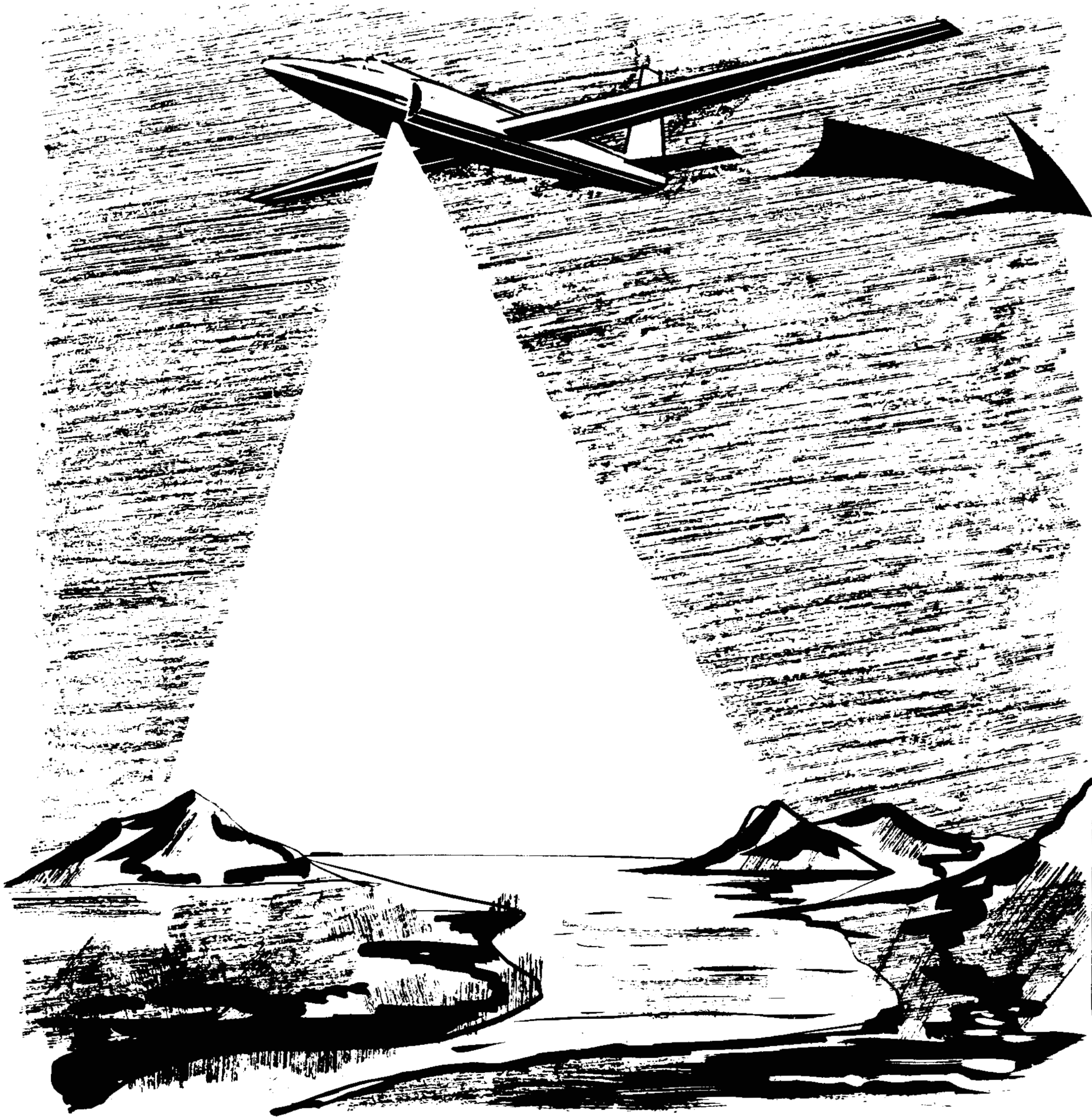
September 26, 1972

EARTH OBSERVATIONS RESEARCH



DATA FLOW



AMES EARTH RESOURCES AIRCRAFT PROJECT

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Release 72-98

SCIENTISTS WILL STUDY YOUNG COMET OVER BERING SEA

AMES RESEARCH CENTER, Mountain View, Calif.--Scientists aboard the NASA observatory aircraft, Galileo, will study fragments from a young comet , the Giacobini-Zinner, on October 8 when Earth passes within only 110,000 kilometers (70,000 miles) of the comet's orbit.

U.S. and Canadian experimenters flying high over the Bering Sea at 12,000 meters (40,000 feet) hope to study the composition of this "new" comet--by aiming 30 cameras, spectrographs, and other optical instruments at the meteor shower that the comet is expected to produce when fragments of it enter and burn up in Earth's atmosphere.

This meteor shower, known as the Giacobinids, is expected to occur between 3:30 and 5:30 a.m. expedition time (7:30 to 9:30 a.m. PDT) October 8. It should be visible in the night sky over 25 per cent of the Earth's surface, from Siberia, North China, Japan, and the northwest Pacific. Because there will be no moon on that night, the meteor display against a dark sky may well be spectacular.

The Giacobini-Zinner comet circles the Sun every seven years, and past intense meteor showers created by it have occurred in 1933, 1946, and 1952. Massive storms of incoming meteors during the 1946 shower reached rates of 10,000 per hour, three every second. During some other passages, meteor displays have been poor or non-existent.

10/2/72

Giacobini-Zinner is called a new comet because it was first seen in 1900. Many scientists believe that all the comets were formed 4.5 billion years ago along with the solar system. There may be 100 billion comets circling the Sun, some as far out as 160 billion kilometers (100 billion miles). Some far-out comets do approach the Sun and, therefore, have orbital periods of hundreds or thousands of years.

When forces such as the planet Jupiter's powerful gravity bring a fresh comet in close to the Sun, scientists try to measure its composition to determine the nature of comets and of the original material of the solar system. Material incoming from the Giacobinids this year is calculated to have left the main body of the comet only 10 to 60 years ago.

The Galileo aircraft is managed by NASA's Ames Research Center, Mountain View, Calif., and will be based at Cold Bay, Alaska, on the tip of the Aleutian Peninsula. Five experimenter groups aboard are from: Ames, NASA's Langley Research Center, Dudley Observatory, Albany, New York, NASA's Marshall Space Flight Center, and the National Research Council of Canada.

Past displays by the Giacobinids have been intense but very brief. Scientists explain this as follows: Material is ejected by all comets due to heating and expansion of their gases as they near the Sun. In the young Giacobini-Zinner, this material is spread out in a compact band along the comet's orbit plane. During Earth's brief passage through the band, the shower occurs. In this year's case, Earth's passage of the comet orbit will be 58 days after the comet itself has passed.

Giacobini-Zinner's orbit now comes so close to Earth's orbit because it has just been "moved over" by Jupiter's powerful gravity. This occurs occasionally on the comet's trips around the Sun.

- more -

Since Giacobini-Zinner is a "slow" comet, traveling 133,000 kilometers per hour (83,000 miles per hour) relative to the Earth, the light spectrum created by its fragments as they burn up in the atmosphere will be simple, and hence easy to measure.

Based on recent laboratory simulations of meteor entry at Ames by C. A. Boittnott and H. F. Savage, experimenters now hope to use light spectra to identify percentages of sodium, calcium, magnesium and iron in the Giacobinid meteors.

Once a comet gets close to the Sun, it tends to break up. In old comets, fragments are widely dispersed for billions of kilometers around the entire orbit, as with the Perseids and Geminids, explains Dr. Ian Halliday, of the Research Council of Canada. Estimates of survival time for Giacobini-Zinner are not much more than 100 solar revolutions.

Three other experimenter groups on board the Galileo for other purposes will be:

1. GCA Corporation, Bedford, Mass. observing artificial clouds in the upper atmosphere, formed by chemicals released from sounding rockets.

2. National Oceanographic and Atmospheric Administration, water vapor measurements in the atmosphere.

3. University of Alaska, aurora borealis observations in connection with an orbiting satellite.

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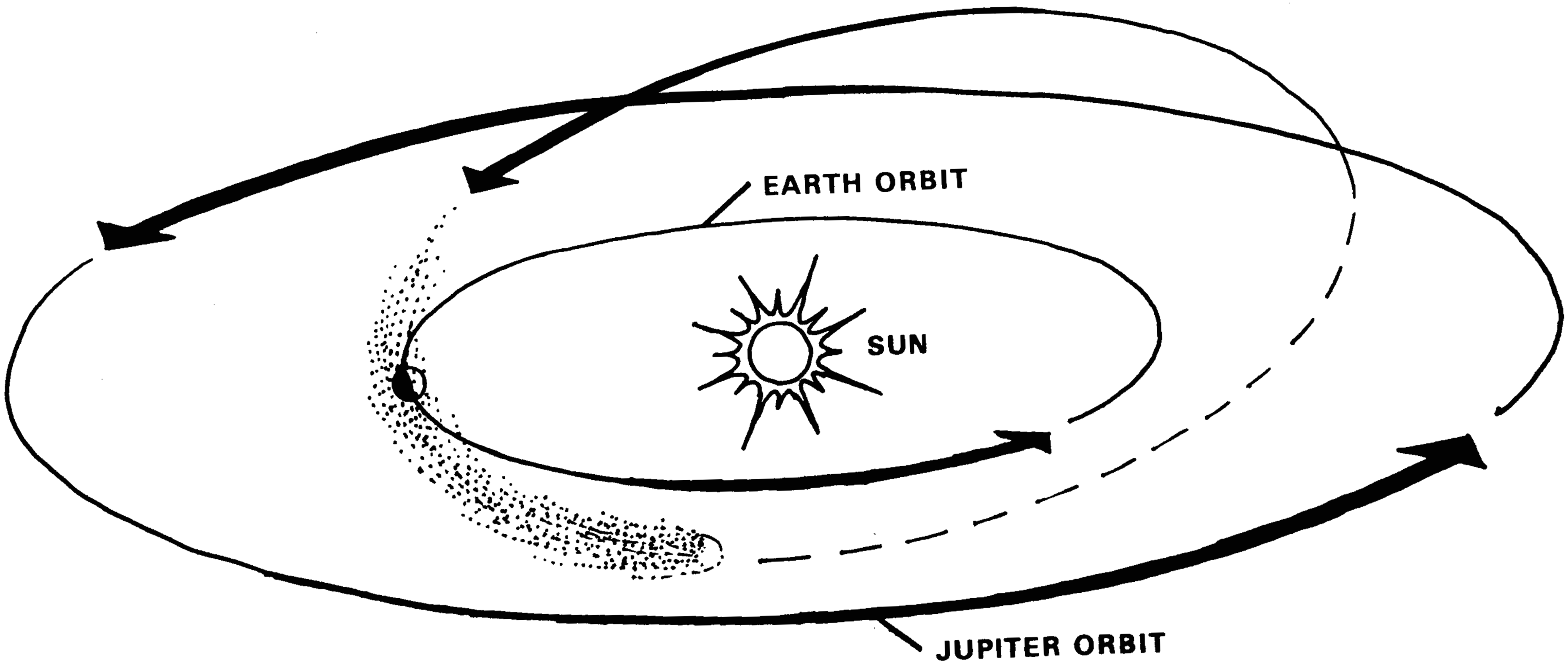

THE ORBIT OF THE COMET, GIACOBINI-ZINNER

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Release 72-136

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AIRCRAFT NOISE ABATEMENT PROCEDURES TO BE STUDIED

AMES REASEARCH CENTER, Mounatin View, California - A flight test program will be conducted under terms of a $1.5 million NASA contract with United Air Lines, Inc., to evaluate operational prodcedures and avionic system designed to help reduce the noise level near airport approach patterns.

The contract is part of a NASA/Ames Research Center program, in cooperation with the Federal Aviation Administrationto further develop and evaluate the operational feasibility of the two-segment landing approach as a means of reducing noise near airport communities.

The avionics system, which will be devloped by Collins Radio Company of Cedar Rapids, Iowa, under another NASA contract, is in the form of a kit for Boeing 727-200 series aircraft. Value of the Collins contract is estimated at $233,000.

In a two segment approach, the aircraft descends at a steeper glide path angle during the initial approach for landing. At a point near the airport where the descending aircraft intersects the normal shallow glide and the final approach and landing are made in the normal manner. Ground noise levels are reduced under most of the approach path because, (1) the aircraft flies at higher altitudes over most of the approach; thus, the noise is further away from the ground; and, (2) the pilot can select reduced power settings because of the steeper glide path.

Over the past several years, the FAA and NASA have both conducted studies to investigate the fesibility of the two-segment approach for aircraft noise abatement. The Ames Research Center, in conjunction with the FAA and American Airlines, has recently completed a flight-test program which incorporated the results of these previous studies to make a preliminary determination of the operational feasibility of this technique for reducing community noise. The tests were successful but were restricted to a single airport and good weather conditions. Further evaluation under conditions more representative of those encountered in routine scheduled service are required before operational feasibility can be completely ascertained.

The results of the tests with American Airlines were presented to the NASA Advisory Ad Hoc Panel on Noise Abatement by Operational Flight Procedures. This panel is composed of individuals representing the airlines, airframe manufacturers, avionics manufacturers, FAA, and professional pilot and airline associations. The Ad Hoc Panel recommended that work on the two-segment approach be continued with an eventual evaluation of a completely operational system by line pilots under conditions representative of those encountered in scheduled service. The program with United Air Lines and Collins Radio Co., is in direct response to the recommendations of the Advisory Panel.

The contract with Collins Radio Company provides for the design and fabrication of an avionics equipment package to assist a pilot in making routine two-segment approaches under all conitions. The contract with United Air Lines provides for installation and flight testing of the avionics package, including a simulation program, engineering flight evaluation, and line pilot evaluation.

The Collins avionics unit will be installed on a B-727 aircraft simulator at Denver, Colorado, where pilot procedures and two-segment approach profiles will be developed for maximum reduction in noise perceived on the ground consistent with adequate safety margin and pilot acceptance. It is anticipated that a 50 per cent noise reduction will be achieved with the two-segmant approach cencept.

Two aircraft will be equipped with the two-segment avionics system and will be used in the evaluation program. The first of these will be used in a series of engineering evaluation flights in a Boeing 727 aircraft at Stockton airport and later at other commercial airports.

Pilots from other airlines and from the various professional pilots organizations will be invited to participate in the evaluation program.

Finally, the system will be installed on a UAL B-727 and flown in regular passenger service for a six-month period.

Work under the UAL contract is scheduled to be completed by October 1973. Engineering flight tests will begin in December 1972.

# # # #

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Ames Release 72-145

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NASA ACCEPTS NEW COMPUTER

AMES RESEARCH CENTER, Mountain View, Calif.---The National Aeronautics and Space Administration Ames Research Center is announcing the successful completion of a contract with the University of Illinois and the Burroughs Corporation for the design, development, and manufacture of the ILLIAC IV computer system now installed at Ames.

The contract was completed this month upon the ILLIAC IV passing the contractual acceptance test requirement of demonstrating the capability of the ILLIAC computer system hardware to achieve the availability requirement, the clock rate, as well as its capability of performing the operations specified in the contract.

Further effort will be required before the entire ILLIAC IV system is operational. It is presently planned that a limited number of user programs will be run in the spring of 1973 and that an operational status will be achieved in the fall of 1973.

The ILLIAC IV, the most powerful computer in existence, will be integrated into a large remote access computer system under development at Ames. This system will include several Digital Equipment Corporation

-more-

12/27/72

(DEC) processors, the UNICON trillion-bit laser store manufactured by Precision Instruments of Palo Alto, Calif., and several other storage units. When operational, the entire system will be a computation resource on the nation-wide Advanced Research Projects Agency (ARPA) network and will be accessible to the universities and government agencies presently on the network. These include such universities as Carnegie-Mellon, Case Western Reserve, Harvard, MIT, Stanford, UCLA, USC and government agencies such as the National Bureau of Standards, the Department of Commerce, in addition to ARPA and NASA.

The ILLIAC IV represents a new form of computer architecture - a parallel array organization employing a single control unit and 64 high speed processing units. For a selective area of problems in which a single list of instructions can effectively operate simultaneously on multiple sources of data, this organization provides an effective speed considerably higher than more conventional serial computers. In addition to the more than eight million bits of memory in the processing units, the ILLIAC IV system has, as secondary storage, a Parallel Disk File System which provides one billion bits of memory with a transfer rate of more than one billion bits per second.

The computer system was conceived six years ago at the University of Illinois and its development has been under the direction of and funded by ARPA. A competitively negotiated contract with Burroughs Corporation was awarded in 1967 for the design, development, and manufacture of the ILLIAC IV. After much essential research and several experiments with various advanced state-of-the-art components, the Burroughs effort was completed at an estimated cost of about $30 million. In 1970, ARPA designated the Ames Research Center as the host site and technical manager of the ILLIAC IV project.

Because of its speed, ILLIAC IV will make possible the solution of problems that are economically unfeasible on a conventional computer or would run longer than acceptable because of real-time constraints. ILLIAC IV will make tractable applications in such fields as global climate dynamics, distant seismic event detection, multi-sensor processing, fluid dynamics simulation and optimization problems arising in logistics or economics.

The Ames Research Center, with its complex of sophisticated wind tunnels will use ILLIAC IV in the field of computational aerodynamics. Here, for the first time, the design of three dimensional wings and wing body combinations can be economically accomplished by the scientist using the computer as his basic tool.

ILLIAC IV should provide a new era in numerical weather prediction. Current efforts to improve the accuracy and duration of weather prediction have been limited by the computation time required by conventional computers to execute the weather simulation. ILLIAC IV will reduce the computational time by a factor of 50 to 100 and should soon make available highly reliable weather forecasts sufficiently long range to be of great value.

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Release 73-17

OCEAN PRODUCTIBITY STUDIES IN ANTARCTICA

A professor from California State University, San Jose, NASA researchers using earth satellites, and Sea-explorer Jacques Cousteau have formed a team to study the productivity of the sea.

Associate professor of biology Ellen Weaver is working with John Arvesen of NASA's Ames Research Center, Mountain View, Calif. to develop instrumentation for eventual use in whole-ocean monitoring by satellite.

They recently have devised a sensor system to monitor ocean temperatures and chlorophyll levels from aircraft. More advanced versions of these aircraft-borne sensors could be put aboard satellites to make continuous globas checks on the food production capacity and pollution levels of the seas.

Currently, Captain Cousteau's crew is making direct measurements of ocean watter conditions off Antarctica from his ship, Calypso, using Ames Research Center equipment. The researchers are using these "ground truth" measurements to derive correlations with ocean color and temperature observations from ERTS, Nimbus, and NOAA satellites.

Says Professor Weaver of her work: "In a world not only hungry, but already far behind in providing adequate protein to its people, the oceans are vital."

- more -

"Many people think the oceans are an infinite resource. On the contrary, according to some estimates, we are taking out more in total tonnage of fish than the oceans can produce. The truth is that we really don't know the total food potential of the seas. We do know that the oceans are an irreplaceable resource which, like our forests and grazing land, must be managed properly for the best return. To avoid destroying the food-chain system of the world's oceans, and to get maximum production of food fish, we must have far more knowledge of the ocean environment than we have now."

Professor Weaver recently returned from Buenos Aires where she installed scientific equipment on the Calypso.

Cousteau, a noted photographer and sea explorer, believes that unless ocean pollution is abated it may destroy the world's seas within 50 years.

Testifying before the Senate Subcommittee on Oceans and Atmosphere last year, Cousteau said that man has damaged from 30 to 50 percent of the Earth's oceans in the past 20 years alone.

Calypso is currently off the Antarctic Peninsula, and will sail up the west coast of South America ending her cruise in San Diego.

During her 10-month voyage, the ship will continuously take fluorimeter and temperature readings of the sea, said Arvesen.

This information is sent five days a week by ATS satellite to Ames Research Center in Mountain View for processing by computer. Dr. Weaver was formerly a National Academy of Science Associate at Ames and Ames supports her current work under a research grant.

The fluorescence level of sea water indicates its approximate chlorophyll content, says Dr. Weaver. High fluorescence means much chlorophyll.

- more -

Chlorophyll is the green substance in plants which, in a process called photosynthesis, converts sunlight energy into chemical energy, she explains.

Too much or too little chlorophyll in the oceans indicates a low food-producing potential. A median amount is necessary for high productivity. Extremely high chlorophyll content may be a sign of pollution. Results of the research are expected to show a correlation between chlorophyll, temperature, and other sea-life observations.

Both chlorphyll and water temperature are closely related to amounts of the microscopic plants called phytoplankton. Phytoplankton are found throughout the oceans and are the basis of virtually all food production of the seas.

In their research using aircraft, Ames researcher Arvesen and Dr. Weaver measured chlorphyll production and pollution. They flew a sensitive monitoring system over bodies of water and recorded two wavelengths of light scattered upward from beneath the surface.

One is the wavelength of sunlight absorbed by chlorophyll. The other is a standard for comparison.

The system can make its comparisons 1400 times a second and can record changes in chlorophyll concentrations instantly.

Previously chlorophyll detection was done point by point, using analytical chemical methods. However, chlorophyll is not static, and this piecemeal type of detection cannot give a complete picture of the constantly changing nature of water pollution, Arvesen explains.

Also some pollutants cannot be detected directly in water. But it is possible to infer their presence by examining the rate of photosynthesis or chlorophyll production.

- more -

Dr. Weaver has been at CSU, San Jose, since 1969. A graduate of Western Reserve University in Cleveland, Ohio, she received her M.S. degree from Stanford University and her PhD degree from the University of California at Berkeley.

- end -

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Release 73-84

EARTH PASSES BETWEEN PIONEER 10 AND THE SUN

The Earth has passed between the Jupiter-bound Pioneer 10 spacecraft and the Sun.

This is the second "inferior conjunction" the spacecraft has experienced since launch to Jupiter in March of 1972. From this point, orbital travel of the Earth will move it away from the spacecraft for the next six months.

Pioneer 10 now is 90 million kilometers (56 million miles) from Jupiter, and 530 million kilometers (330 million miles) from Earth. The unmanned spacecraft will reach Jupiter on December 3, for history's first visit to the giant planet.

These are figures inconsistent with NASA Release 73-164 (Aug 18, item)

When the spacecraft, the Earth and Sun are lined up, Pioneer 10's sun sensors must look almost directly at the Sun. This interferes with the sensors' count of spacecraft rotation rate.

90 million km
530 million km
620 million km
73-164 says 620 million mi from Jupiter

To avoid this problem, flight directors at NASA's Ames Research Center, Mountain View, California, near San Francisco are keeping the pointing direction of Pioneer 10's radio beam and sun-sensor one and a half degrees from the Sun, and one degree from the Earth.

according to Feb 15 1973 A+A the distance is 1 billion km = 620 million mi

This has not interfered with radio communications.

As it swings around Jupiter, Pioneer 10 will return images

- more -

8/7/73

of the planet and measurements of its radiation belts, atmosphere, interior, and satellites. Pioneer 11 also en route to Jupiter will reach the giant planet in December of 1974.

Pioneer 11, now is 150 million kilometers (93 million miles) from the Earth.

Both Pioneers continue to function well.

- end -

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FOR RELEASE:
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Nancy Baker 415/965-5091

(Nancy Baker, a journalism student at San Jose State University, is presently serving her summer internship in the Public Affairs Office at NASA's Ames Research Center.)

Release 73-90

NEW APPROACH TO SMOG RESEARCH

A new research project to measure the composition and trace the movements of Bay Area smog is now underway using an Ames Research Center light aircraft and various ground stations to document the air pollution problem in the San Francisco Bay area, including such sub-regions as the Livermore and Santa Clara Valleys.

Since late July, flights have monitored the complex factors of wind currents, traffic, sunlight intensity and pollution composition to relate regional air quality to local pollutant emissions and those from neighboring regions.

The two-year project, is funded by the National Science Foundation. It involves the use of aircraft, radiosonde balloons and ground station measurements to gather meteorological and pollution data. These data are needed to verify a computer model, or program, which can be used to assess the environmental impact of land use plans and air quality control stratagies.

- more -

Three different agencies are collaborating in the program. Bay Area Air Pollution Control District (BAAPCD) will use its ground stations to obtain ground based data. NASA's Ames Research Center, Mountain View, California, will make atmospheric measurements from the airborne laboratory. Ames will also conduct computer studies in photochemistry to determine how sunlight chemically affects pollution. Lawrence Livermore Laboratory, operated by the University of California for the Atomic Engergy Commission, will then use the massive amount of weather and pollution data to verify the model they are developing at their complex computer facilities.

This model of the Bay Area, said Dr. Ronald Reinisch of Ames Research Center, may be used to show how air quality is affected by future land development, such as the building of a new industrial complex.

The BAAPCD is establishing criteria for the model and will be its ultimate user. The program is a very practical one, said Dr. Reinisch, not just a detached scientific study. "The end product of this study will be a computer model that the BAAPCD can operate to test various stratagies."

Radiosonde balloons launched by San Jose State University meteorology students will also gather data under a grant from Ames. Professor Al Miller's students will help to operate a newly opened station on Mt. Sutro in San Francisco, and will also assist in interpreting the data.

Another grant with the Statewide Air Pollution Research Center at the University of California, Riverside, will provide hydrocarbon analysis.

Although the first series of aircraft flights have taken place in the San Francisco Bay region and Livermore Valley, the study will eventually expand to include all nine counties under jurisdiction in the BAAPCD (about 6000 sq. miles).

The program will provide a comprehensive picture of pollution concentration in the Bay Area, and utilize the varied capabilities of the three agencies to study smog at the surface and below the inversion. Also it is one of a few projects dealing simultaneously with the problems of both smog dispersion and land use -- a necessary feature for any long-range pollution decisions.

- end -

NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Ames Research Center
Moffett Field, Calif. 94035

FOR RELEASE:
IMMEDIATE

Release 73-107

Stan Miller 415/965-5091
(home 408/356-6849)

FEMALES AS SHUTTLE PASSENGERS UNDER STUDY

AMES RESEARCH CENTER, Mountain View, Calif. -- Clinical research in female physiology to develop selection criteria for women passengers in Space Shuttle missions begins at NASA's Ames Research Center this week, as follow-on to similar studies on men conducted last year.

Twelve volunteers are joining a five-week experiment to find out how weightlessness and reentry Gs may affect the female body. After two weeks of orientation and preliminary medical studies, eight of the 12 nurses will simulate weightlessness by absolute bedrest and four will act as amblatory control subjects. After two weeks of immobility the eight women will be subjected to G forces expected when the Shuttle enters the atmosphere at the end of a mission. The last week is for recovery and final testing.

Because men and women are nature's only naturally upright two-footed animals, they have developed cardiovascular ability to keep their blood evenly distributed, despite the pull of gravity. Part of the experiment's objective is to see how well

- more -

women can resist the tendency for blood to pool in the legs after a period without gravity and subsequent cardiovascular deconditioning already observed in male astronauts.

Another object is to determine female tolerance to the long period of low G forces which Shuttle reentry will create. The third objective is to measure specific physiological changes induced by the simulated weightlessness. These measurements are on biorhythms, body biochemistry, cardiovascular responses, and changes and effects of endocrine gland activity under the stress of simulated spaceflight. Much of the data on the females will be compared to similar data on males to determine the reaction differences.

Medical literature on many of test objectives for females is scarce or non-existent. The results and conclusions are therefore regarded vital as criteria for the selection of Shuttle passengers, both male and female.

The studies will be in a carefully controlled laboratory environment at the Ames Human Research Facility for the bedrest and laboratory parts of the test. An Ames centrifuge is to be used for the G-tolerance testing. At both facilities, a variety of safety precautions and teams of physicians, technicians and consultants will monitor each test activity.

Several biomedical measuring devices developed at Ames are to be used in the experiment. One of these is a capsule that radios exact temperatures from inside the body to laboratory recording devices.

Nurse volunteers were called for because of their medical and flight training. It is not required that they be in so-called prime physical condition like Mercury, Gemini and Apollo astronauts, but their general health is like that expected of Space Shuttle flight candidates.

The 12 subjects are all U.S. Air Force flight nurses, ten from Reserve units in the California area and other Western states. For the 5 weeks of the study they will be employed under a NASA contract. Two active duty nurses are under the direction of Col. Claire M. Garrecht, Command Nurse with the U.S.A.F. Tactical Air Command at Langley Air Force Base in Virginia and the 10 Reserve nurses under the direction of Col. Pearl Tucker, Special Assistant for Reserve Nursing Services Office of the Chief A.F.R., Washington, D. C.

Principal investigator for the experiments is Dr. Harold Sandler, Chief of the Biomedical Research Division at Ames. The project is under the overall direction of Dr. Charles Berry, Director for Life Sciences at NASA Headquarters.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Ames Research Center
Moffett Field, Calif. 94035

FOR RELEASE:
IMMEDIATE

Stan Miller 415/965-5091
(home 408/356-6849)

Release 73- 128

ACID CLOUDS OF VENUS

The upper levels of the brilliant clouds of Venus, long a challenging puzzle to astronomers, consist of droplets of sulfuric acid more concentrated than the acid in an automobile battery.

This conclusion was reached by a team of space scientists headed by Dr. James B. Pollack from NASA's Ames Research Center, Mountain View, Calif. They arrived at the identification by measuring the infrared "color" of Venus from a Learjet aircraft and comparing the results with a computer simulation of the color properties of a wide variety of substances.

The possibility that the Venus clouds are made of sulfuric acid has been independently suggested by Dr. Andrew T. Young of NASA's Jet Propulsion Laboratory, Pasadena, Calif. and Father Godfrey T. Sill of the Lunar and Planetary Laboratory, Tucson, Arizona. These investigators pointed out that concentrated sulfuric acid is a very effective drying agent and could account for the surprisingly low amount of water vapor present near the cloud tops. They also showed that sulfuric acid solutions could match certain other known properties of the Venus clouds. However, while these other studies indicated that sulfuric acid was a good candidate, it required the aircraft observations to make a positive identification.

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While similar to its neighbor planet Earth in mass and size, Venus has a very different atmosphere. The Venus atmosphere contains a hundred times more gas than Earth's atmosphere and almost all of the Venus gas is carbon dioxide, only a minor constituent in Earth's atmosphere. Because of this massive atmosphere, the suface temperature of Venus is a very uncomfortable 750 degrees Kelvin (900 degrees Fahrenheit).

The new aircraft experiment results provide another point of comparison. The dense upper portions of Venus clouds have the same chemical composition as a similar but more tenuous layer of sulfuric acid particles in the Earth's stratosphere.

The aircraft findings may provide important information for the design of future spacecraft missions to Venus, such as an entry probe mission currently being considered by NASA. This result may also contribute to a better understanding of the formation of sulfate particles in the Earth's stratosphere. The information in turn is needed by scientists attempting to assess the possible climactic effects of supersonic transports which fly at stratospheric altitudes and contribute to the population of sulfuric acid particles.

For some time, scientists at NASA and elsewhere have been checking the spectral characteristics of several possible constituents of Venus clouds. These characteristics include the way in which they are expected to absorb and reflect light at different wavelengths of the spectrum. From these data, Dr. Pollack was able to predict how cloud droplets of different substances would absorb specific "colors" of light in the infrared region of the spectrum, a region in which several molecular signatures are found.

But it was necessary to check the absorption spectrum of sunlight reflected from Venus in the most scientifically interesting part of the infrared spectrum. Blanketing effects of water vapor in the Earth's own atmosphere which produce a broad signature in that same region had to be overcome. This called for taking a recording instrument high into the Earth's atmosphere where it would look at Venus while above the Earth's water vapor.

During the summer of 1972, observations were made from the NASA Learjet flying at 14,000 meters (45,000 feet). At the high altitude, there is only a thousandth of the water vapor found in the atmosphere at sea level and a hundredth the amount of water vapor above the highest mountain top observatory.

The Learjet is one of several research aircraft operated by NASA Ames for the benefit of the scientific community.

The aircraft carried an astronomical telescope of 30 centimeters (12 inches) aperture which concentrated light from Venus onto a photoelectric recording device. The light was filtered to allow only wavelengths of infrared light from 1.2 to 4.5 microns to pass through at known times.

These observations were compared with the computer generated absorption spectra derived from the laboratory studies of the various possible clouds such as iron chloride, liquid water, ice, mercury, ammonium chloride, and hydrochloric and sulfuric acids in several concentrations.

All the calculated curves differed significantly from the observed curves except for one -- sulfuric acid. Moreover, the peaks and valleys and form of observations were best matched by sulfuric acid concentrations of 75 percent or larger.

Dr. Pollack stresses that the observations provide information only about the topmost cloud layer. Other deeper layers may still consist of different materials, and there is no way of obtaining information about them except by penetrating into the clouds. This would require a space probe sent to Venus with instruments designed to sample and analyze the deeper layers, he says.

The scientific team at Ames conducting the experiment include Drs. Edwin F. Erickson, Fred Witteborn and Charles Chackerian, Jr.; Mrs. Audrey Summers, Mrs. Betty Baldwin, Mr. Warren Van Camp, Mr. Gordon Augason and Dr. Lawrence Caroff.

Now there is little doubt. Sulfuric acid droplets in the Venus upper atmosphere provide the brilliant cloud tops that make Venus the brightest object in the evening sky right now (not counting the Moon). But in this sister planet to Earth whose atmosphere somehow went wrong and became inimical to life as we know it, mysteries still abound.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA 94035

REPLY TO ATTN OF DI

73-236
NOTE TO EDITORS:

NASA's Ames Research Center will accredit and have press facilities for newsmen for the Pioneer 10 encounter with Jupiter on December 3, 1973.

Pioneer 10 will reach periapsis (point of closest approach to Jupiter), 81,000 miles above Jupiter's cloud tops at 6:26 p.m., PST, on Dec. 3. Forty-six minutes will be required for data transmission from Jupiter, making periapsis time on Earth 7:12 p.m. Pioneer 10 data will be in the form of experiment results and color pictures of Jupiter and its moons.

Among the major events during the encounter period will be: early color images, early determination of Jupiter's bow shock and magnetic field, images and measurements of the four planet-sized Galilean moons, planet images, spacecraft survival of the radiation belts, quick look results (a "planet model"), and enhanced images.

Pioneer 10, which will have traveled a billion kilometers (620 million miles) since launch March 2, 1972, has set an array of records. The spacecraft has traveled faster and farther than any man-made object. It was the first to fly beyond Mars, made the first crossing of the Asteroid Belt, and will become the first man-made object to escape the Solar System.

It will not be necessary to make formal application for accreditation, but it would be helpful for planning purposes if you notify us by letter or telephone (415/965-5091) by Nov. 26, if you plan to attend. We will be glad to send you a list of nearby hotel accomodations.

Access badges and parking permits will be issued at the News Center, Bldg. 201, upon presentation of credentials. Entry to Ames should be by the NASA Gate.

The News Center will be open daily from Nov. 26 to Dec. 8. Hours will be determined by mission events.

Information on special telephone and communications requirements can be obtained from Brad Gibbs or Bob DeRenzy at 415/965-5001.

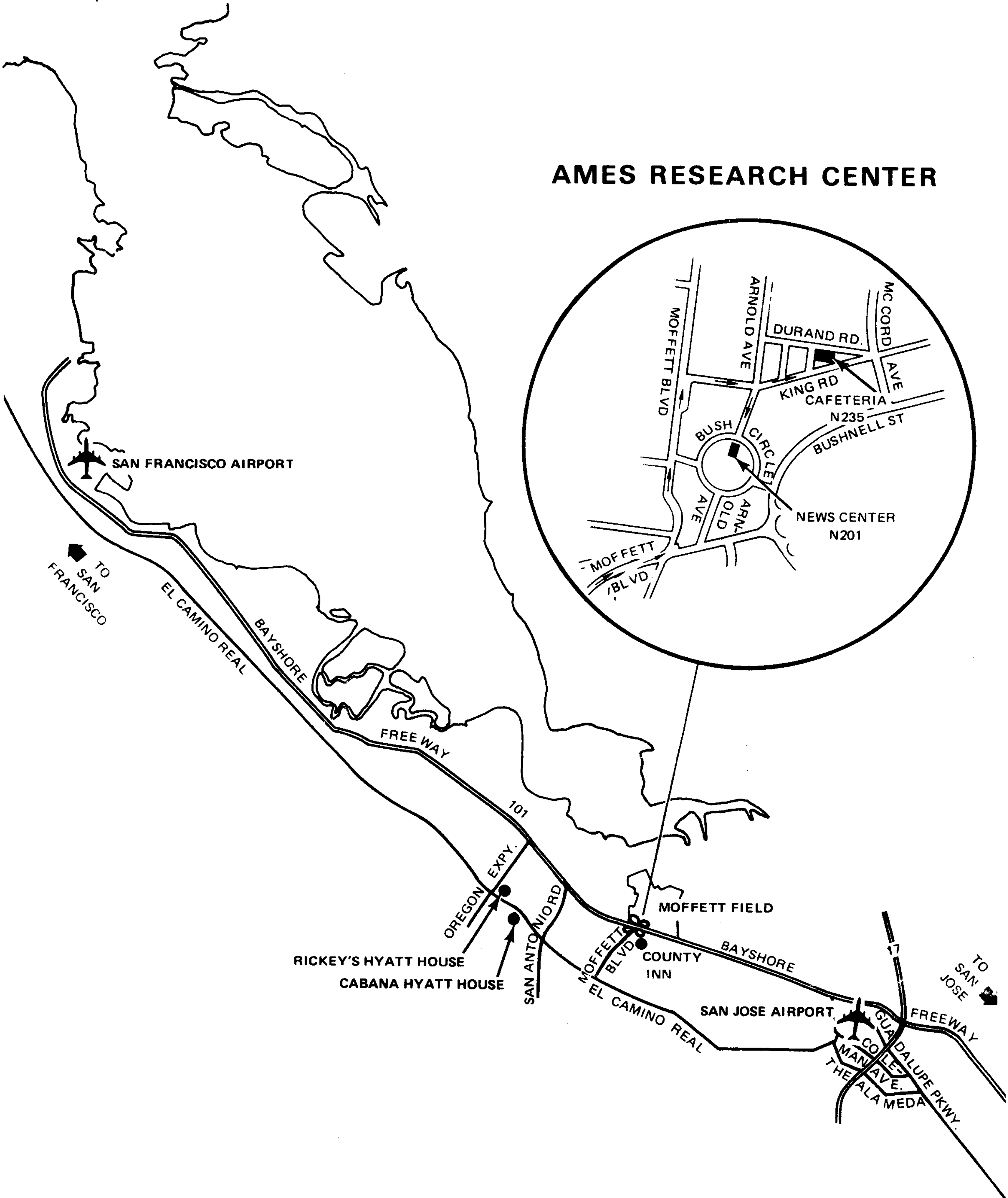
Please call 415/965-5091 if you need special information on facilities available for radio, television or print coverage.

Enclosed are: area map and building location for Ames; list of planned briefings; and a listing of operational events during the Pioneer 10 encounter with Jupiter.

Stan Miller
Ames Public Affairs Officer

Pete Waller
Pioneer Information Manager

AMES RESEARCH CENTER



PRELIMINARY

ENCOUNTER NEWS

EVENTS SCHEDULE

DATE	SUBJECT	PARTICIPANTS
Nov. 19 Monday P-14	Pre-encounter news briefing. Headquarters, Washington	-Project Manager -Program Manager -Project Scientist
Nov. 23 Friday P-10	Periapsis-minus-10-day tour of PMOC. Last opportunity to get inside. Conducted by C.F. Hall.	
Nov. 26 Monday P-7	Begin imaging 24 hours per day.	
Nov. 26-29 P-7 to 4	Encounter with Jupiter bow shock.	
Nov. 28 Wednesday P-5	Begin Public Affairs Remote Television System (RTS) operation.	-Hofstetter
Nov. 29 Thursday 10 a.m. P-4	Imaging System background briefing.	-Gehrels -Swindell -Tomasko -Coffeen
Nov. 29 Thursday 2 p.m.	Spacecraft/Mission-highlights background briefing: *Spin axis pointing *640 days, arrive within 40 seconds *How control spacecraft with 45 minutes delay *70 km/second speed and change within few cm/second	-Hall -Holtzclaw -Hofstetter -Martin

DATE	SUBJECT	PARTICIPANTS
Nov. 30 Friday 10 a.m. P-3	Second full-scale pre-encounter news briefing (first will be in Headquarters.) Bulletins on far-encounter pictures, bow shock and magnetic field.	-Project Manager -Project Scientist -Program Manager -Ed Smith
Nov. 30 Friday 2 p.m. P-3	Radiation Belts background briefing.	-Van Allen -McDonald -Fillius -Simpson -Ed Smith
Dec. 1 Saturday 10 a.m. P-2	Jupiter Science background briefing (review of all science).	-Most PIs -Project Scientist -Program Scientist -Program Manager
Dec. 1 Saturday 2 p.m. P-2	Bow Shock results.	-Wolfe -Ed Smith
Dec. 2 Sunday P-1	Panel of guest experts on Jupiter and possibility of life there.	-Kuiper -Sagan -Warwick -Kvenvolden -Brad Smith
Dec. 2-3 Sunday Monday P-1&0	Real time encounter activity.	
Dec. 3 Monday P-0	Io occultation.	

DATE	SUBJECT	PARTICIPANTS
Dec. 4 Tuesday 10 a.m. P+1	Immediate Post-encounter briefing.	-Kramer -Hall -all PIs -Wolfe
Dec. 4 Tuesday 2 p.m.	Analysis of early Real-Time pictures, including Jupiter Moons, results.	-Gehrels -Munch -Swindell -Kliore -Ed Smith
Dec. 5 Wednesday 10 a.m. P+2	Clouds, Atmosphere and Ionosphere, aurorae background/early results briefing (primarily background).	-Gehrels -Judge -Kliore -Swindell -Munch
Dec. 6 Thursday 10 a.m. P+3	Jupiter's interior and mass distribution. Jupiter's orbit and Moons' orbits, Moons' relation to magnetic field, dust belts (if any).	-Gehrels -Swindell -Kliore -Ed Smith -Soberman -Kinard
Dec. 7 Friday 10 a.m. P+4	Release of enhanced pictures at Ames.	-Swindell -Gehrels -Coffeen -Tomasko
Dec. 7 Friday 10 a.m. P+4	Jupiter temperature distribution briefing dark side, red spot, ice caps (?), "hot shadows", heat balance.	-Munch -Gehrels

DATE	SUBJECT	PARTICIPANTS
Dec. 8 Saturday 10 a.m. P+5	Thorough quick-look science briefing. (This should be as early as possible--maybe Thursday or Friday.)	-Hall -most PIs -Wolfe
Dec. 12 Wednesday P+9	Presentation of preliminary interplanetary results on P-10, plus additional encounter quick-look data at AGU, San Francisco.	-Hall -most PIs
Feb.20, 1974	Post encounter summary briefing and presentation of Jupiter planet model for future Jupiter missions.	

ENCOUNTER TIME LINE

NOTES:

1. All distances measured from Jupiter's surface (cloud tops).
2. P = Periapsis (closest approach).
3. R_J stands for Jupiter radius.
4. R_J = 71,372 km (44,350 miles).
5. All times PST.

11-3-73 — P – 30 days

Start Pioneer encounter.

11-4-73 — P – 29 days

First imaging and polarimetry of Jupiter by University of Arizona Imaging Photo-polarimeter (IPP) instrument.

After this date, from 3 to 8 hours of imaging and polarimetry every day through November 25, 1973, as well as from Dec. 11, 1973 to Jan. 2, 1974.

11-8-73
2:26 a.m. — P – 25 days, 16 hours

Cross orbit of Hades, Jupiter's outermost moon, at 329 R_J, 23,630,000 km (14,680,000 miles) from Jupiter.

10:26 a.m. — P – 25 days, 8 hours

Cross orbit of Poseidon at 325 R_J, 23,202,000 km (14,420,000 miles) from Jupiter.

11-9-73
12:26 a.m. — P – 24 days, 6 hours

Cross orbit of Pan, 312 R_J, 22,273,600 km (13,840,000 miles) from Jupiter.

11-11-73
10:26 a.m. — P – 22 days, 8 hours

Cross orbit of Andrastea at 289 R_J, 20,632,000 km (12,820,000 miles) from Jupiter.

11-22-73
2:26 p.m. — P – 11 days, 4 hours

Cross orbits of Demeter and Hera at 163 R_J, 11,636,600 km (7,231,000 miles) and 11,655,600 km (7,243,000 miles) from Jupiter.

6:26 a.m. — P – 11 days, 12 hours

Cross orbit of Hestia at 159 R_J, 11,400,600 km (7,084,000 miles) from Jupiter.

11-24-73
6:26 p.m. — P 9 days

Earliest date for entering Jupiter's bow shock wave in the solar wind. Should occur some time in six-day period 11-24-73 to 11-30-73, P – 9 days to P – 3 days.

11-24-73 cont'd.

This event shows presence of Jupiter's magnetic field The bow shock will be measured by the Jet Propulsion Laboratory (JPL) magnetometer and Ames Research Center plasma (solar wind) instrument

11-25-73	P 8 days
6:26 p.m.	Pioneer 10 is 8,333,580 km (5,180,000 miles) from Jupiter.
11-26-73	
All day	12 images of Jupiter. Polarimetry of Jupiter and Io.
4:00a.m.	P - 7 days, 14 hours to P - 7 days, 6 hours, 4:00 a.m. to 12:00 p.m. Last spacecraft attitude change before periapsis, and until 8:26 p.m. Dec. 5 (P + 2 days 2 hours). This is the last adjustment of spacecraft pointing at Earth (for communications) prior to encounter. For the JPL celestial mechanics experiment. it is essential to eliminate spacecraft thrusts during encounter. The experimenter uses gravity effects on the spacecraft trajectory to calculate Jupiter's mass distribution and mass and orbits of moons.
6:00 p.m.	Begin 23-hour-a-day imaging and polarimetry for 15 days through Dec. 10, P – 7.5 days. Both imaging and polarimetry of Jupiter will occur every day through this period, imaging a little more than half the time.
6:26 p.m.	P – 7 days Pioneer 10 is 7,455,000 km (4,633,000 miles) from Jupiter
11-27-73	
All day	26 images of Jupiter Polarimetry of Io, Ganymede, Jupiter
All day	Jupiter marble-sized in 8 x 8 inch (14° x 14°) view-frame of imaging instrument.
4:00 a.m.	Trim maneuver if greater pointing accuracy required than achieved in yesterday's maneuver. 6 hour period, 4 a.m. to 10 a.m.
6:26 p.m	P – 6 days Pioneer 10 is 6,560,550 km (4,077,000 miles) from Jupiter.
11-28-73	P – 5 days
6:26 p.m.	Pioneer is 5,645,300 km (3,508,000 miles) from Jupiter.
6:26 p.m.	P – 5 days Earliest time for passage of magnetopause, actual entrance to Jupiter's magnetic field. This will occur in a 3.5 day period between 11-28-73 and 12-1-73, from P – 5 days to P – 1 day, 12 hours.

<u>11-29-73</u>

All day — 25 images of Jupiter. Polarimetry of Ganymede, Europa, Jupiter.

6:26 p.m — P – 4 days

Pioneer is 4,703,400 km (2,923,000 miles) from Jupiter.

<u>11-30-73</u>

All day — 20 images of Jupiter. Polarimetry of Callisto, Io, Europa, Jupiter.

2:26 p.m. — Begin first view of Jupiter in ultraviolet (UV) light with University of Southern California ultraviolet photometer. Will last 38 hours, 3 minutes (from 2:26 p.m. Nov. 30 to 4:29 a.m. Dec. 2). P – 76 hours to P – 37 hours, 57 minutes.

First UV period considered prime because of potential radiation background interference during second closer view on Dec. 3. Will investigate atmosphere composition and search for possible auroral activity. Observations cover 1,673,919 km (1,040,000 miles) of flight, from 3,892,700 km (2,419,000 miles) from Jupiter to 2,218,800 km (1,378,800 miles) from Jupiter.

6:26 p.m. — P – 3 days

Latest time to enter Jupiter's bow shock wave.

6:26 p.m. — P – 3 days

Pioneer is 3,722,400 km (2,313,000 miles) from Jupiter.

<u>12-1-73</u>

All day — 26 images of Jupiter, 2 images of Io. Polarimetry of Ganymede, Callisto, Jupiter.

All day — Jupiter golf-ball-sized in 8 x 8 inch (14° x 14°) view-frame of imaging system.

6:26 p.m. — P – 48 hours

Point on incoming trajectory where spacecraft imaging resolution becomes better than resolution of largest Earth telescopes. Based on 100 or more picture elements across the planetary disc. Best Earth telescopes get from 80 to 150 elements, but over 100 is rare.

6:26 p.m. — P 48 hours

Pioneer is 2,681,000 km (1,666,000 miles) from Jupiter.

<u>12-2-73</u>

All day — 23 images of Jupiter, 2 images of Io, 2 images of Callisto, 2 images of Ganymede. Polarimetry of Ganymede, Callisto, Jupiter.

1:00 a.m. — P – 17.2 hours

Jupiter is 3 inches in diameter in 8 x 8 inch (14° x 14°) view-frame of imaging system.

4:28 a.m. — End first UV view of Jupiter (see 11-30-73).

12-2-73 cont'd.

6:26 a.m.	P – 1 day, 12 hours Latest time for passage of Jupiter's magnetopause, actual entry into the planet's magnetic field.
7:05 a.m.	P – 35 hours, 21 minutes Infrared (IR) view of Callisto with California Institute of Technology Infrared Radiometer. Will determine Callisto's heat characteristics.
7:26 a.m.	P – 35 hours Pioneer is 29 R_J, 2,070,000 km (1,286,000 miles) from Jupiter.
12:26 p.m.	P – 30 hours Cross orbit of Callisto at 25.4 R_J, 1,810,400 km (1,125,000 miles) from Jupiter.
6:26 p.m.	P – 1 day Pioneer is 1,526,200 km (948,380 miles) from Jupiter.

12-3-73

All day	18 images of Jupiter, 1 image of Io, 1 image of Europa. Polarimetry of Jupiter.
3:17 a.m.	P – 15 hours, 9 minutes Infrared view of Ganymede.
4:26 a.m.	P – 14 hours Closest approach to Callisto 1,410,000 km (876,000 miles).
2:26 a.m.	P – 16 hours Cross orbit of Ganymede at 14 R_J, 999,208 km (622,700 miles) from Jupiter. Ganymede is Jupiter's largest moon.
5:56 a.m.	P – 12 hours, 30 minutes Closest approach to Ganymede, 446,250 km (277,300 miles).
8:40 a.m.	Start second ultraviolet view of Jupiter. View period 4 hours, 48 minutes from 8:40 a.m. to 1:28 p.m., P – 9 hours, 46 minutes to P – 4 hours, 58 minutes. Radiation may saturate instrument during this second view period.
10:26 a.m.	P – 8 hours Cross Europa's orbit at 8.4 R_J, 599,400 km (372,500 miles) from Jupiter.
10:26 a.m.	P – 8 hours Jupiter just fills 8 x 8 inch (14° x 14°) view-frame of imaging system.
11:08 a.m.	P – 7 hours, 18 minutes Infrared view of Europa.

12-3-73 cont'd.

6:26 p.m. P – 0 days

Closest approach to Amalthea's orbit, 18,500 km (11,470 miles).

Amalthea is Jupiter's smallest and closest moon.

6:36 p.m. P + 10 minutes

Crossing Jupiter's equatorial plane – Location of a potentially hazardous dust ring. NASA-Langley Research Center meteoroid detector will count dust particles. General Electric Co. Asteroid-Meteoroid Telescope will make dust observations during encounter, if not saturated by radiation.

6:41:45 p.m. Begin 1 minute, 31 second occultation by Io, 6:41:45 to 6:43:16 p.m., P + 15 minutes, 45 seconds to P + 17 minutes, 16 seconds. Jet Propulsion Laboratory experimenter will determine whether Io has an atmosphere and an ionosphere by studying effects on spacecraft radio signal of its passage by the moon. Io's atmosphere is not measurable from the Earth.

7:42 p.m. Begin 65 minute occultation by Jupiter, from 7:42 to 8:47 p.m. (P + 1 hour, 16 minutes to 2 hours, 21 minutes).

Determine planet's ionospheric structure and investigate nature of neutral atmosphere via studies on Earth of spacecraft radio signal effects. (See Io occultation just above.) During this time, Pioneer is out of contact with Earth.

8:16 p.m. Begin solar eclipse of spacecraft – Flight through Jovian night (shadow).

Duration is 51 minutes, 8:16 p.m. to 9:07 p.m. (P + 1 hour, 50 minutes to P + 2 hours, 41 minutes).

12-4-73

All day 23 images of planet looking back at thin crescent Jupiter. Polarimetry of Jupiter, Io.

12:26 a.m. Exit hard radiation region.

6:26 p.m. P + 1 day

Pioneer is 1,526,200 km (948,256 miles) from Jupiter.

12-5-73

All day 22 images of Jupiter. Polarimetry of Europa, Ganymede, Callisto, Jupiter.

6:26 p.m. P + 2 days

Pioneer is 2,681,000 km (1,666,000 miles) from Jupiter.

6:26 p.m. Earliest time to exit magnetopause outbound.

12-6-73 P + 2 days, 20 hours

4:00 a.m. First precession (adjustment of spacecraft attitude) after periapsis. 8-hour period, 4:00 a.m. to 12 noon.

All day 16 images of Jupiter. Polarimetry of Io, Jupiter.

6:26 p.m. P + 3 days
Pioneer is 3,722,000 km (2,313,000 miles) from Jupiter.

<u>12-7-73</u>

All day 31 images of Jupiter. Polarimetry of Callisto, Ganymede, Europa, Jupiter.

6:26 p.m. P + 4 days
Pioneer is 4,703,000 km (2,922,000 miles) from Jupiter.

<u>12-8-73</u>

All day 25 images of Jupiter. Polarimetry of Io, Ganymede, Europa, Jupiter.

6:26 p.m. P + 5 days
Pioneer is 5,645,000 km (3,508,000 miles) from Jupiter.

<u>12-9-73</u>

All day 38 images of Jupiter. Polarimetry of Callisto, Io, Jupiter.

6:26 a.m. Earliest time to exit through Jupiter's bow shock in the solar wind. Begins 10.5 day period when shock front exit could take place. Latest time of exit is 12-20-73. (Period is P + 5.5 to P + 20 days.)

6:26 p.m. P + 6 days
Pioneer is 6,560,300 km (4,076,000 miles) from Jupiter

<u>12-10-73</u>

All day 20 images of Jupiter. Polarimetry of Callisto, Jupiter.

6:26 p.m. P + 7 days
Pioneer is 7,455,100 km (4,633,000 miles) from Jupiter.

<u>12-11-73</u>

Return to imaging and polarimetry only 3 to 8 hours per day each day through Jan. 2, 1974.

6:26 p.m. P + 8 days
Pioneer is 8,334,000 km (5,180,000)miles from Jupiter

<u>12-19-73</u> P + 16 days
Latest time to exit bow shock.

<u>1-2-74</u> End Jupiter encounter.

TENTATIVE BRIEFING PARTICIPANTS

Coffeen, Dr. David L.	University of Arizona, co-investigator, Imaging Photopolarimetry experiment
Fillius, Dr. R. Walker	University of California at San Diego, principal investigator, Jovian Trapped Radiation Experiment
Gehrels, Dr. Tom	University of Arizona, principal investigator, Imaging Photopolarimetry experiment
Hall, Charles F.	Ames, Pioneer Project Manager
Hofstetter, Robert U.	Ames, Mission Analysis and Launch Coordination
Holtzclaw, Ralph W.	Ames, Pioneer Spacecraft System Manager
Judge, Dr. Darrell J.	University of Southern California, Los Angeles, principal investigator, Ultraviolet Photometry experiment
Kinard, William H.	Langley Research Center, principal investigator, Meteoroid Detection experiment
Kliore, Dr. Arvydas J.	Jet Propulsion Laboratory, principal investigator, S-Band Occultation experiment
Kochendorfer, Fred D.	NASA Headquarters, Washington, Pioneer Program Manager
Kuiper, Dr. Gerard P.	University of Arizona
Kvenvolden, Dr. Keith	Ames, Chief, Chemical Evolution Branch
Martin, Norman J.	Ames, Mission Control Manager
McDonald, Dr. Frank B.	Goddard Space Flight Center, principal investigator, Cosmic Ray Energy Spectra experiment
Mead, Dr. Gilbert D.	Goddard Space Flight Center
Munch, Dr. Guido	California Institute of Technology, principal investigator, Jovian Infrared Thermal Structure experiment
Opp, Dr. Albert G.	NASA Headquarters, Washington, Pioneer Project Scientist
Sagan, Dr. Carl	Cornell University
Simpson, Dr. John A.	University of Chicago, principal investigator, charged Particle Composition experiment

Smith, Dr. Bradford A.	New Mexico State University
Smith, Dr. Edward J.	Jet Propulsion Laboratory, principal investigator, Magnetic Fields experiment
Soberman, Dr. Robert K.	General Electric, Drexel University, principal investigator, Asteroid-Meteoroid Astronomy experiment
Swindell, Dr. William	University of Arizona, co-investigator, Imaging Photopolarimetry experiment
Tomasko, Dr. Martin	University of Arizona, co-investigator, Imaging Photopolarimetry experiment
Van Allen, Dr. James A.	University of Iowa, principal investigator, Jovian Charged Particle experiment
Warwick, Dr. James W.	University of Colorado
Wolfe, Dr. John H.	Ames, Pioneer Project Scientist

NEWS
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Ames Research Center
Moffett Field, Calif. 94035

FOR RELEASE:
IMMEDIATE

Release 74-9

Pete Waller 415/965-5091
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PIONEER 11 EMERGES FROM ASTEROID BELT

The Pioneer 11 spacecraft, which will arrive at Jupiter next December 5, will complete its passage through the Asteroid Belt on March 20. This will be history's second trip through the 251 million kilometer (156 million mile)-wide Belt. Pioneer 10 completed the first crossing of the Belt in February 1973.

Pioneer 11 appears to have found generally the same conditions in the Belt as did Pioneer 10. However, the modified meteoroid detector on Pioneer 11 has found some unexpected variations in dust particle concentrations.

Most recent findings by Pioneer 10 about the Belt and interplanetary dust are now available. Between the Belt and Jupiter, there are almost no dust particles at all.

Pioneer 11 now is 70 per cent of the way to Jupiter, and has covered 700 million kilometers of its billion kilometer (620 million mile) curving flight path to the giant planet. Pioneer 11 currently is 682 million kilometers (424 million miles) from Earth, and is traveling about 50,000 km/hr (31,000 mph) along its flight path.

The Asteroid Belt forms a doughnut-shaped region, lying between the orbits of Mars and Jupiter. Some 150 million miles wide, the Belt is 80 million kilometers (50 million miles) thick so spacecraft cannot fly over

-more-

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or under it. The Asteroids are small bodies, most of them less than a mile in diameter, that travel around the Sun like small planets. Several hundred have been identified and named but thousands more exist.

Pioneer 10 and 11 findings appear to have pretty well eliminated what was thought to be the principal danger of the Asteroid Belt--the presence of "high-velocity projectiles", small very-high-speed particles which might penetrate spacecraft and do serious damage. Particles in the center of the Belt orbit the Sun at about 61,200 km (38,000 miles) per hour. This is fast enough for a meteoroid with a mass of 1/1000th of a gram to penetrate one centimeter (about 3/8 of an inch) of aluminum.

However, most of the particles seen by Pioneer 10 and 11 were smaller than 1/1000th gram, and total numbers of particles seen were far lower than many predictions.

Though the Belt contains bodies as big as Texas, plus substantial dust, the predicted dangerous concentrations of high-velocity dust particles apparently do not exist.

The findings of Pioneer 10 and 11 now are:

Going out from the Earth's orbit, the smallest particles (around 1/100th mm diameter) actually appear to decline in numbers. Somewhat larger particles (1/100th to 1/10th mm diameter) seem to be evenly distributed, with some regional variations, all the way from the Earth's orbit to the far side of the Belt with no increase in the Belt. (There are 25 mm to an inch).

Still larger particles (1/10th to 1 mm diameter) were found from Earth's orbit out to the Belt's outer edge. But these particles were almost three times as frequent in the center of the Belt as near Earth. Particles larger than 1 mm diameter appear to be very thinly spread.

By particle size: The smallest particles (around 1/1000 mm diameter) are identified by measurements of zodical light reflected from the total mass of these particles as one looks away from the Sun. These measurements have shown that going away from the Sun zodical light declines steadily. If these very small particles were mostly in the Asteroid Belt, the sunlight reflected from them would have remained relatively constant until the Belt was reached, and then would have dropped rapidly as the spacecraft passed through the Belt.

The rate of decline of this reflected sunlight suggests that instead, outward from the Earth concentrations of these tiniest particles decline steadily as the square of the distance from the Sun.

Recent Pioneer 10 results suggest that there are virtually none of the very small particles in the Asteroid Belt. Experimenters had had difficulty subtracting the generalized glow of starlight from that of sunlight reflected from interplanetary dust. However, recent measurements of "pure, undulterated starlight," as experimenter Dr. Martha Hanner, State University of New York, Albany, calls it, have been taken on both sides of Jupiter's orbit, where dust is believed almost non-existent. These show about the same starlight level as skylight levels in the Asteroid Belt. This means no dust reflection and hence no dust in the Belt.

In the small asteroid particles, 1/100 mm to 1/10 mm diameter (one billionth to one millionth of a gram) -- Pioneer 10 found no increase in the Asteroid Belt. Experimenter William Kinard, Langley Research Center, believes the particles measured both inside and outside the Belt are debris from comets, not asteroid fragments. For these particles, Pioneer 10's one quarter square meter of gas-cell detector surface received 25 penetrations between the Earth's orbit and the Belt, 17 penetrations in the Belt, and 12 penetrations between the Belt and Jupiter.

The modified gas-cell instrument aboard Pioneer 11 found some different results from Pioneer 10's. Walls of the gas cells on Pioneer 11 were thicker so that only particles from 1/50th to 1/10th mm diameter (1/100 millionth to

1/millionth of a gram) were measured. This means the range of particles measured on Pioneer 10 was divided in half for Pioneer 11 and only the larger particles in this range were measured.

For these particles, about half as many gas-cell penetrations were found near the Earth by Pioneer 11 as by Pioneer 10. And this means about the same numbers of small and large particles there. However, between 112 million and 214 million miles from the Sun Pioneer 11 found a virtual desert of larger particles recording only one penetration. In the Asteroid Belt, the larger particles appeared again, but only about a sixth as many as in the total range measured by Pioneer 10. This appears to mean that in the Belt smaller particles in the 1/100 to 1/10 mm range are three times as frequent as larger particles.

Between the Earth and the outer edge of the Belt, Pioneer 11 counted 20 penetrations, 7 of these in the Belt.

The larger asteroidal particles, measured by the asteroid-meteoroid telescope, are most of them in the 1/10 mm to 1/mm diameter range (one ten millionth to one ten thousandth of a gram), with a few of the particles seen by Pioneer 10 as large as 10 to 20 centimeters in diameter. Analyses of Pioneer 10 data suggest that there are almost three times more of these larger particles inside the Belt as between the Earth and the Belt.

Spot checks of Pioneer 11 data suggest that its findings of numbers of these larger particles were about the same as those of Pioneer 10.

Latest analysis of Pioneer 10 data shows that in the region both inside and outside, of Jupiter's orbit, larger particles are almost non-existent. In fact, between Jupiter's orbit and the Belt none were seen.

Experimenter Dr. Robert Soberman, General Electric Co., believes that particles in the belt are slowed and pulled in by a combination of solar radiation and gravity, accounting for the larger numbers of particles between the Belt and the Earth's orbit. Between the Earth and Jupiter, the asteroid telescope on Pioneer 10 counted 250 particles, about half of which were measured in the Belt.

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Release 74-10

PIONEER 11 TO BE RETARGETED

NASA will change the course of Pioneer 11 to make it skim within 42,000 km (26,000 miles) of Jupiter, then fly back across the solar system on an extended five-year trip to Saturn.

The course change is calculated to provide investigators with much better data on Jupiter than would have been possible from a repetition of the 1973 Pioneer 10 mission.

Pioneer 10 flew past the equatorial portion of Jupiter last December at a distance of 131,000 km (81,000 miles), taking photographs and making measurements.

On its new course, Pioneer 11 will pass the giant planet closer to the polar region, covering a much wider range of latitudes and coming three times closer than its predecessor.

Controllers at NASA's Ames Research Center, Mountain View, Calif., will command the firing of Pioneer 11's thrusters late in March or in mid-April to make the course change.

mid April

The change in velocity will slow the spacecraft, bringing it to within 42,000 km (26,000 miles) of Jupiter's banded cloud tops on Dec. 5. Pioneer will approach the planet from below Jupiter's south pole, then be pulled rapidly upward by Jupiter's

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enormous gravity, intersecting Jupiter's equatorial plane at an angle of 55 degrees. The spacecraft will then exit from Jupiter, well above the planet's north pole.

The close approach to Jupiter will speed up the spacecraft to 175,000 km/hr (110,000 mph), relative to the planet. This speed, plus the high angle of approach to the disc-like radiation belts, should bring Pioneer through Jupiter's zone of intense radiation very rapidly. It is hoped that this will reduce the cumulative radiation dose to spacecraft systems to acceptable limits. If Pioneer 11 can survive this passage it will measure the thickness of Jupiter's radiation belt and pave the way for future Jovian orbiting missions planned for 1981.

Under the new plan, Pioneer 11 will fly in front of Jupiter (to the left as seen from Earth) as it moves in its orbit. The spacecraft will then pass behind the planet, emerging on Jupiter's right side. With such a passage, Jupiter's gravity and orbital motion will kill some of Pioneer's velocity, putting it into a looping orbit toward the opposite side of the solar system. This will first bring Pioneer inside Jupiter's billion-mile-diameter orbit, then far out beyond Jupiter's orbit until it intersects Saturn's orbit and encounters the ringed planet.

If the course-change maneuver is successful, Pioneer 11 will reach Saturn in September 1979, 6 1/2 years after its launch. This is well beyond the spacecraft's design lifetime, but there is a fair possibility that it will be at least partially operational and able to return data.

The added bonus of a Saturn encounter could provide preliminary data on such things as the planet's radiation belts, if any, the nature of its rings, its heat environment, and other phenomena. If Pioneer's imaging system continues to function, it could return man's first close-up views of Saturn and its rings.

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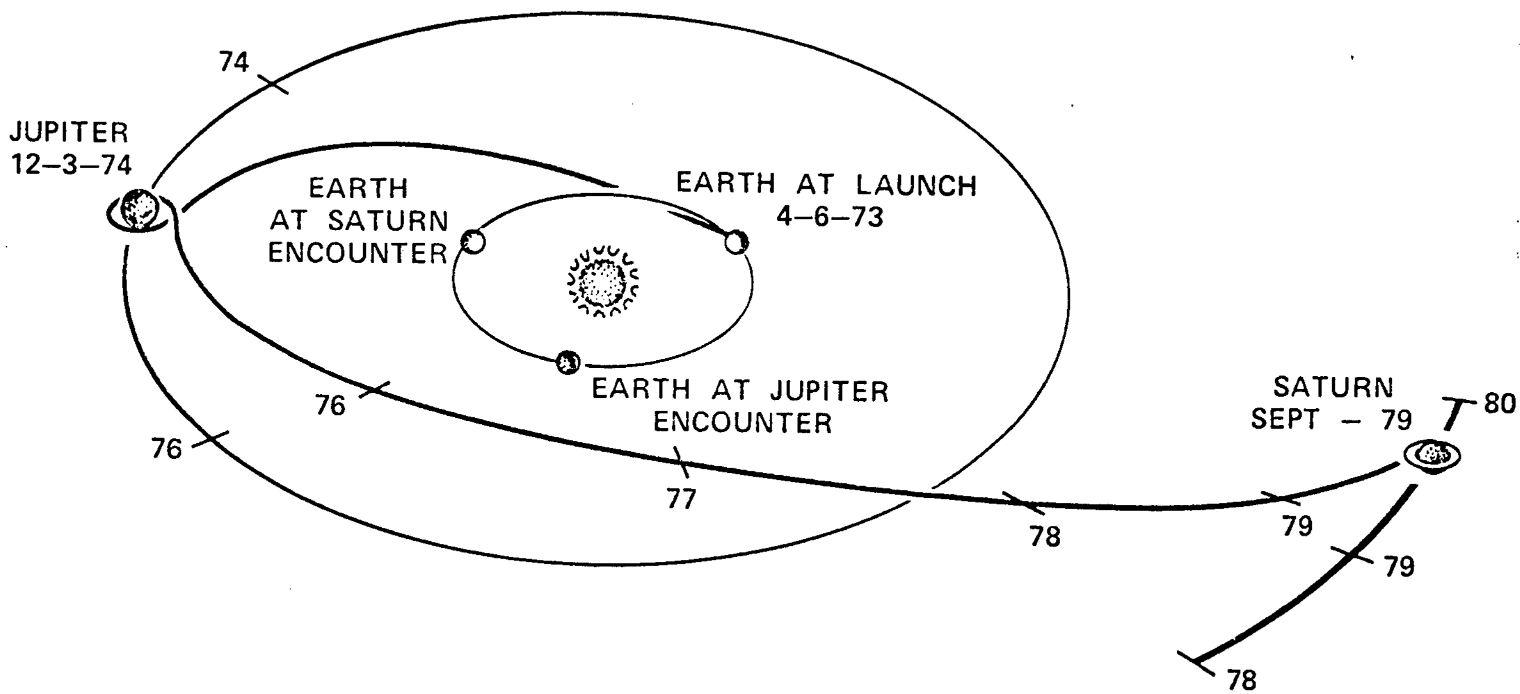
PIONEER 11
SATURN TRANSFER TRAJECTORY



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Release 74-21

AMES WORKSHOP WILL STUDY OUTER PLANET PROBES

AMES RESEARCH CENTER, Mountain View, Calif. -- The traditional approach to exploring new planets has been first a fly-by mission, then an orbiter mission, and then flying a craft into the atmosphere. With greater experience gained by trips like Pioneer 10's safe passage through Jupiter's enormous radiation belts, plus advances in atmosphere probe technology, scientists are thinking about plunging directly into the atmospheres of planets like Jupiter, Saturn, and Uranus. A relatively small and cheap atmosphere probe spacecraft would make it possible to take the somewhat increased risks.

To study this question, 120 scientists and engineers from industry, universities, and NASA will meet for three days at NASA's Ames Research Center, Mountain View, California, from Tuesday, May 21, to Thursday, May 23.

During this Outer Planet Probe Technology Workshop, participants will consider spacecraft which would fly past a

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planet, while also sending a probe vehicle into its atmosphere to report on composition, clouds, pressure variations, and other things.

They will look at the possibility of visiting such planet-sized moons as Saturn's Titan, which may have a life-supporting atmosphere and is as large as Mercury.

The Workshop will review various mission definitions, requirements, subsystems, hardware, and required future research. They will be especially interested in the problem of heating during entry into the atmospheres of the giant outer planets.

A central question will be the costs of various combinations of outer planet missions, and what is the most economical set of missions. Proposed planet missions that will get special attention are: probe missions to either Saturn or Uranus, and the effect of Titan and Jupiter options on both performance and cost. Another would be adding an atmosphere probe to a Uranus fly-by mission, or using a similar design for a Saturn atmsophere probe. Further possibility is a combination Jupiter orbiter and probe mission.

Because the outer planets are so cold, they are believed to be made of the primordial material from which the solar system formed. By combining studies of several planets, scientists can learn how the individual planets formed, about formation of the solar system as a whole, and about evolution of the Earth.

Weather scientists are in agreement that understanding the ebb and flow of the atmospheres of other planets is one of the best routes to understanding the Earth's weather, which is not understood now.

The three-day workshop at Ames is sponsored by the Planetary Programs Directorate at NASA Headquarters, Washington, D.C.

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Release 74-24

AMES TO HOST LAND USE PLANNING SEMINAR

AMES RESEARCH CENTER, Mountain View, Calif. -- The use of data gathered by satellites and high-flying aircraft, usually in the form of photographs, to assist in land use planning will be the subject of a seminar at Ames Research Center June 13 and 14.

Approximately 50 state and local government resource managers are expected to attend and participate in the two-day series of discussions.

Recent years have seen great strides in the art of "remote sensing"; the gathering of ground-level data from aircraft or spacecraft. The launching of the Earth Resources Technology Satellite in July, 1972, provided the first repetitive imaging of the earth surface for application to earth resources disciplines, including land use planning.

Seminar participants will hear presentations on the use of remote sensing data in dealing with problems of land use, on state-of-the-art techniques in the interpretation of remotely-sensed data and on the integration of such data with information from other more conventional sources.

Specific examples of the use of remotely-sensed land use information and its effect on the decision-making process will also be presented.

Dr. Alan J. Stratton of the Space Applications Branch at Ames is Chairman for the seminar.

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NASA PRESENTS ACHIEVEMENT AWARDS FOR PIONEER, JUPITER

The National Aeronautics and Space Administration will confer its highest individual and group awards on some 50 members of the Pioneer 10 team in recognition of their outstanding contributions to the spacecraft's successful flight past Jupiter December 3, 1973.

Dr. James C. Fletcher, Administrator of the National Aeronautics and Space Administration, Washington, D. C., will present the awards on August 16, at the NASA Ames Research Center, Mountain View, California.

Date confirmed ARC PIO interview 18 July 75

The NASA awards include the Distinguished Service Medal, Exceptional Service Medal, Medal for Exceptional Scientific Achievement, Public Service Award, Group Achievement Award, and the Public Service Group Achievement Award.

Charles F. Hall, Manager of the Pioneer Project, Ames Research Center, will receive NASA's highest award, the Distinguished Service Medal, for his "outstanding leadership and

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dedicated performance in managing the Pioneer Project at Ames since its inception in 1962."

The NASA Exceptional Service Medal will be presented to the following honorees:

Richard O. Fimmel, Chief Science Operations, Pioneer Project, Ames Research Center, for his "outstanding effort in managing the science interface activities for Pioneer 10, and in particular the Jupiter encounter."

John V. Foster, Director of Development, Ames Research Center, for his "outstanding leadership in support of management and administrative performance of the Pioneer Project."

Robert U. Hofstetter, Manager, Launch Vehicle and Operations, Pioneer Project, Ames Research Center, for his "outstanding leadership related to the Pioneer mission analysis activities and launch vehicle interface coordination and to the mission operations during the Pioneer 10 encounter of Jupiter."

Ralph W. Holtzclaw, Manager, Spacecraft Systems, Pioneer Project, Ames Research Center, for his "outstanding leadership in performance related to the Pioneer 10 spacecraft design and development."

Harold Jaffe, Manager, Isotopes Flight Systems, Division of Space Systems, U. S. Atomic Energy Commission, for his outstanding leadership solving major technical problems which could have threatened the availability of Radioisotope Thermoelectric Generator (RTG) flight units for the Pioneer 10 Mission which would have precluded a launch during the 1972 Jovian opportunity."

William E. Kirhofer, Project Engineer/Mission Analysis, Trajectory Consultant and Navigation Team Chief, Jet Propulsion Laboratory, for his "outstanding contributions to the Pioneer 10 spacecraft navigational analyses and the subsequent planning and execution of spacecraft midcourse maneuvers from launch to encounter with Jupiter."

Fred Kochendorfer, Manager, Pioneer Program, NASA Headquarters, for his "outstanding leadership in coordinating the administrative and financial management affairs of the Pioneer Program at NASA Headquarters."

James R. Johnson, Pioneer Project Representative, Unmanned Launch Operations, Kennedy Space Center, for his "outstanding contributions to the successful planning and implementation of the Pioneer 10 spacecraft prelaunch and launch operations at Cape Kennedy."

Eldon W. Kaser, Chief, Development Projects Contract Branch, Ames Research Center, for his "outstanding leadership and dedicated performance related to initiation and administration of the contract activities for the Pioneer 10 mission."

Edwin T. Muckley, Project Engineer, Atlas/Centaur Project Office, Lewis Research Center, for his "outstanding contribution to development of the launch vehicle system for the Pioneer 10 mission."

Robert R. Nunamaker, Manager, Mission Operations System, Pioneer Project, Ames Research Center, for his "outstanding performance and leadership relative to the planning and conduct of the mission operations for the Pioneer 10 Mission."

Joseph E. Lepetich, Manager, Experiment Systems, Pioneer Project, Ames Research Center, for his "outstanding performance and leadership as related to the Pioneer Science Payload design development, and integration with the Pioneer 10 spacecraft."

Norman J. Martin, Chief of Mission Operations, Pioneer Project, Ames Research Center, for his "outstanding performance and leadership as related to the Pioneer 10 Mission Operations and in particular for the Jupiter encounter."

Alfred J. Siegmeth, Manager, Deep Space Network, Pioneer Project, Jet Propulsion Laboratory, for his "outstanding effort in support of the Pioneer 10 Mission tracking, data acquisition and command requirements."

Arthur C. Wilbur, Chief, Systems Development Branch, Flight Project Development Division, Ames Research Center, for his "outstanding performance and leadership as related to the design, development and integration of the Radioisotope Thermoelectric Generator (RTG) power sources into the Pioneer 10 spacecraft system."

The NASA Medal for Exceptional Scientific Achievement will be awarded to the following:

Dr. John D. Anderson, Celestial Mechanics Experiment, Principal Investigator, Jet Propulsion Laboratory, for his "outstanding scientific accomplishments and contributions as Principal Investigator for the Pioneer 10 Celestial Mechanics

Experiment, which has made major contributions of importance on the gravity fields and orbits of Jupiter and its satellites."

Dr. R. Walker Fillius, Jovian Trapped Radiation Experiment, Principal Investigator, University of Calif., San Diego for his "successful accomplishment of all scientific objectives originally proposed for this experiment. The results of this experiment have made major contributions of fundamental importance to the understanding of the nature of the radiation field of the planet Jupiter."

Dr. Thomas Gehrels, Imaging Photopolarimetry Experiment, Principal Investigator, University of Arizona, for his "exceptional achievement as Principal Investigator for the Pioneer 10 Imaging Photopolarimetry experiment, which made major contributions to the understanding of the nature of the physical features and atmosphere of Jupiter and its satellites and of the zodiacal light beyond Earth's environment."

Guido Munch, Jovian Infrared Thermal Structure Experiment, Principal Investigator, California Institute of Technology, for his "exceptional scientific achievement as Principal Investigator for the Jovian Infrared Thermal Structure experiment, which obtained some of man's first direct measurements of the Jovian thermal structure."

Dr. John Simpson, Charged Particle Composition Experiment, Principal Investigator, University of Chicago, for his "outstanding scientific accomplishments and contributions as Principal Investigator for the Charged Particle Composition experiment.

Results on the distribution of high energy particles from this experiment have been a major contribution to the understanding of the radiation environment of Jupiter."

Dr. Darrell Judge, Ultraviolet Photometry Experiment, Principal Investigator, University of Southern California, for his "outstanding scientific accomplishments and contributions as Principal Investigator for the Pioneer 10 UV Photometry Experiment, which obtained results of fundamental importance to the understanding of the nature of the Jovian environment and several of the Galilean Satellites."

William H. Kinard, Meteoroid Detector Experiment, Principal Investigator, Langley Research Center, for "exceptional achievement as Principal Investigator for the Meteoroid Detector experiment, which has made major contributions to the understanding of the particulate matter in the interplanetary medium between the orbits of Earth and Jupiter."

Dr. James H. Trainor, Cosmic Ray Energy Spectra Experiment Co-Investigator, Goddard Space Flight Center, for his "outstanding scientific accomplishments and contributions as Co-Investigator for the Cosmic Ray Energy Spectra experiment. The results of this experiment, which made some of man's first direct measurements of the Jovian energetic particle environment, have made contributions of major importance to the understanding of Jupiter's radiation field."

Dr. James A. Van Allen, Jovian Charged Particles Experiment, Principal Investigator, University of Iowa, for his "exceptional achievement as Principal Investigator for the Jovian Charged Particles Experiment, which has made major contributions of fundamental importance to the understanding of the interplanetary medium beyond the orbit of Mars and of the nature of the radiation field of Jupiter."

The NASA Public Service Group Achievement will be presented to the following teams:

Pioneer Jupiter Team, TRW Systems Group, for "outstanding performance and excellence in the design, development, integration and test of the Pioneer 10 spacecraft system that led to the successful achievement of the mission objectives."

Pioneer Radioisotope Thermoelectric Generator Team, Teledyne Isotope Energy Systems Div.; Los Alamos Scientific Laboratory; Monsanto Research Corp., Mound Laboratory; Oak Ridge National Laboratory, for "outstanding contributions to the timely design, development, and manufacture of the RTG's which served as the primary source of power for the Pioneer 10 Mission."

Pioneer Jupiter Team, Bendix Field Engineering Corp., for "outstanding performance and excellence in providing computer programming and data processing and the flight mission support of the Pioneer 10 Mission."

Pioneer 10 Scientific Instrument Team, for "exceptional effort in the development of equipment of unusual precision and versatility, for flawless instrument performance throughout the Pioneer 10 mission and for fulfillment of the stated experiment objectives."

The NASA Group Achievement Award will be presented to the following teams:

Ames Pioneer 10 Mission Analysis and Launch Operations Team, for "exceptionally effective and timely flight mission design, maneuvering, planning and launch vehicle and operations coordination which resulted in major contributions to the successful achievement of the Pioneer 10 mission objectives."

Ames Pioneer 10 Project Management Team, for "highly effective and timely overall technical, administrative and financial management, and control of the Pioneer Jupiter Project which contributed significantly to the successful achievement of the Pioneer 10 mission objectives."

Ames Pioneer 10 Mission Operations Team, for "the highly effective and timely planning, management and control of the Pioneer Jupiter mission operations that contributed to the successful flight operations of the Pioneer 10 spacecraft and to the achievement of the mission objectives."

Ames Pioneer 10 Spacecraft Team, for "the exceptionally effective and timely technical direction of the Pioneer Jupiter spacecraft development that led to the successful launch and flight operation of the Pioneer 10 spacecraft system and to the achievement of the mission objectives."

Ames Pioneer 10 Scientific Instruments Team, for "highly effective and timely technical direction of the Pioneer Jupiter scientific instrument development and the mission operations support which contributed significantly to the successful performance of the instruments and to the achievement of the Pioneer 10 mission objectives."

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Ames Pioneer 10 Contracts Team, for "highly effective and timely implementation and administration of the procurements for the Pioneer Jupiter project which contributed to the achievement of project milestones on schedule, and to the overall success of the Pioneer 10 mission."

Ames Research Center Support Groups, for "highly effective and timely support of the Pioneer Jupiter Project that contributed significantly to the Pioneer 10 mission success."

Mission Analysis Team, Jet Propulsion Laboratory, for the "outstanding contributions by the Pioneer Jupiter Team of the Mission Analysis Division to the design of the Pioneer 10 mission and the orbit determination and navigation of the Pioneer 10 spacecraft."

Ground Data System Team, Jet Propulsion Laboratory, for "outstanding performance and excellence in development and operation of the ground tracking and data system for the Pioneer 10 mission."

Pioneer 10 Team, U.S. Atomic Energy Commission, for the "exceptionally effective and timely manner in which the team provided flight and safety qualified Radioisotope Thermoelectric Generators and Radioisotope Heater Units for the Pioneer Mission."

Pioneer 10 Radio Science Team, for the "highly effective and timely effort that resulted in the innovative development and implementation of the successful Celestial Mechanics and S-Band Occultation experiments on the Pioneer 10 mission."

Pioneer 10 Headquarters Staff Support Group, for their "outstanding individual and collective contribution to, and dedicated support of, the cooperative effort that was vital to the success of Pioneer 10, the first space flight to Jupiter.

Those being honored with the NASA Public Service Award are:

Bernard J. O'Brien, Manager, Pioneer Project, TRW Systems Group, for "outstanding performance and leadership as Project Manager for the Pioneer 10 spacecraft prime contractor."

Dr. Herbert A. Lassen, Manager, Advanced Scientific Spacecraft Systems, TRW Systems Group, for "outstanding performance and leadership as the key person in the conceptual design of the Pioneer 10/11 spacecraft for the Pioneer Jupiter mission."

Dr. William J. Dixon, Assistant Project Manager for System Engineering, TRW Systems Group, for "outstanding performance and leadership as the Assistant Project Manager for System Engineering for the Pioneer 10 spacecraft prime contractor."

William F. Sheehan, Assistant Project Manager for Assembly, Test and Launch, TRW Systems Group, "outstanding leadership and performance in managing the spacecraft contractor's responsibilities for Pioneer 10 assembly, test and launch activities."

Louis A. Watts, Project Manager, Pioneer Jupiter Imaging Photopolarimeter, Santa Barbara Research Center, for "outstanding performance and leadership in managing the design, development and launch support of the imaging photopolarimeter for Pioneer 10."

Walter L. Natzic, Manager, Pioneer Mission Operations, Bendix Field Engineering Corporation, for "outstanding performance in managing the Pioneer 10 mission operations support services contractor team."

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Release 74-41

PIONEER 11 SPIN RATE CHANGED FOR ENCOUNTER WITH JUPITER

Controllers of the Pioneer 11 spacecraft, fast approaching Jupiter have changed the spin rate of the spacecraft in order to improve measurements of Jupiter's radiation belts during fly-by of the planet this December.

Pioneer instruments look out from the spinning spacecraft and scan a full circle as Pioneer rotates about five times a minute. The slight increase in spin rate was made by controllers at NASA's Ames Research Center, Mountain View, Calif., at the request of Dr. James A. Van Allen, University of Iowa. The spin rate change will provide Dr. Van Allen better data in less time, on Jupiter's intense radiation belts.

Pioneer 11 now is about 85,000,000 km (523,000,000 miles) from the giant planet and will reach there on Monday, December 2, 1974, completing history's second trip to the solar systems largest planet. Jupiter is a spectacular planet and contains more than two thirds of all the planetary material in the solar system.

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Controllers will be taking somewhat of a calculated risk by sending the spacecraft three times closer to Jupiter than Pioneer 10 came last December -- into the heart of Jupiter's intense radiation belts. However, if the fly-by is successful, this close brush with Jupiter will allow Pioneer 11 to use the planet's immense gravity to make history's first flight to Saturn, reaching the ringed planet in 1979.

During its closest approach Pioneer 11 will reach speeds up to 110,000 miles per hour, the fastest speed ever reached by a man made object.

Spacecraft controllers changed Pioneer 11's spin period from one revolution every 12.32 seconds to one revolution every 11.865 seconds. This small increase in rotation rate also improved somewhat the resolution of the pictures of the planet. (Allowing the spin scans of the spacecraft camera to come closer together on the planet's surface, and miss fewer areas. The missed areas are due to the spacecraft's tremendous speed during the closest parts of its passage by Jupiter.)

The increase in spacecraft rotation rate was accomplished by Pioneer's "spin-up" thruster, which was used for the first time. Ames controllers performed the spin-rate maneuver on August 23. They made 8 half-second thrusts and a number of 1/8 second thrusts to reach the precise 11.865 spin period required.

Signals commanding the thrusts were sent from both Canberra, Australia; and Cebreros, Spain, Deep Space Network stations and will cross some 400 million miles of space to reach Pioneer.

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Release 74-47

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NASA EXPEDITION TO HAWAII

Hickam Air Force Base in Hawaii is to be a temporary home base for one of NASA's high flying Earth Resources Survey Aircraft (a Lockheed U-2) for a month of scientific missions beginning October 1.

Primary mission for the aircraft is to probe the stratosphere 20 kilometers (12 miles) high to detect the distribution and extent of ozone, nitric oxide, and pollutants south of Hawaii from the equator to about 40 degrees north latitude.

The stratospheric sampling phase of the Hawaii expedition is a part of a semi-global study conducted by NASA's Ames Research Center to aid a national research program concerned with how these gässes and particles may affect the world's climate over a long period of time. Similar missions covering the higher latitudes and the polar region have been based at the Ames Research Center in Mountain View, California, and Eielson Air Force Base near Fairbanks, Alaska. These have been the first attempts to make detailed measurements at such altitudes and latitudes.

Three other objectives of the mission are to photograph and scan various locations on Oahu, the island of Hawaii, Maui and possibly Kauai. One study will compare photos of lava flows on the island of Hawaii and Maui with suspected volcanic regions on the Moon, Mars and Mercury.

Another study is to use cameras, an infrared scanner and an ocean color scanner to develop techniques for using remote sensing to help the Hawaii State Department of Planning and Economic Development (DPED) manage land use, water quality, recreation, pollution, erosion, sedimentation, and reef die-back. Kaneohe Bay is the primary area selected for the study with Kauai as a back-up site in case of cloudy weather on Oahu.

If flight time is available, another mission would make photos over the island of Hawaii to aid the Institute of Pacific Islands Forestry, U.S. Department of Agriculture, in their research on Ohia and Mamani trees on the slopes of Mauna Kea. These trees are dying and the cause is presently unknown.

Photos made by the NASA aircraft are in the public domain and will be available from the U.S. Department of Interior, EROS Data Center, Sioux Falls, South Dakota, about two months after the study is complete.

The cooperative program with the DPED is the result of recent meetings between Richard Kawakami, Chairman of the Committee on Water, Land Use and Development, Hawaii House of Representatives; Tadao Beppu, Speaker of the Hawaii House of Representatives; and Clarence A. Syvertson, Deputy Director of the Ames Research Center, who is the overall manager of the Hawaii Expedition. Kenji Nishioka, a research scientist with the Ames Systems Studies Division and a native of Hilo, Hawaii, is the project manager.

Ames Research Center operates two Earth Resources Survey Aircraft and has since 1971 been making high altitude flights to support various NASA programs, other state and federal agencies and independent investigators. They have also flown disaster assessment flights such as documentation of flood damage, inspection of forest lands in Oregon and Washington for Tussock moth infestations, and have aided forest fire fighters by providing near real-time photos of fire areas. The aircraft were placed on indefinite loan to NASA by the U.S. Air Force in 1971.

The NASA team in Hawaii for the expedition is headed by Martin A. Knutson, manager of the Ames Earth Resources Aircraft Project. Max Lowenstein and Guy Ferry of Ames are principal investigators for the stratospheric data collection and are part of the Stratospheric Project Research team headed by I. G. Poppoff. Bill Murphy and Staff Sergeant Mike Laughlin at Hickam Air Force Base are assisting NASA in flight operations.

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Ames Research Center
Moffett Field, California 94035

For Release:
Monday February 10, 1975

Pete Waller 415/965-5091
(home 415/493-9406)

Release 75-1

CEREMONY WILL MARK ISSUANCE OF PIONEER-JUPITER COMMEMORATIVE STAMP

The first flights to the planet Jupiter by NASA's Pioneer spacecraft will be marked on February 28, by the issuance of a commemorative 10-cent postage stamp.

Ceremonies in honor of the event are slated for 6 p.m. that day in the Ames Research Center's main hangar at Moffett Field for invited guests, philatelists and others interested in Pioneer. The Pioneer-Jupiter stamp is the first issuance of a commemorative stamp in the Bay Area for many years.

Pioneer 10 made a number of major discoveries about Jupiter, and took the first close-up photos of the giant planet, in 1973. It is now leaving the solar system, the first man-made object to do so. This flight was followed by more spectacular pictures of the brightly-colored planet during a three-times-closer pass by Pioneer 11 last December. Pioneer 11 now is headed for Saturn, the first trip to the ringed planet.

The 570-pound, unmanned Pioneers each flew one billion kilometers (620 million miles) to reach Jupiter, which contains more than two-thirds of the planetary material in the solar system.

The Postal Service has printed 140 million of the colorful Pioneer-Jupiter commemorative stamps, and will open a temporary branch Post Office at Ames on the first day of their issuance.

The joint NASA-Postal Service ceremonies will include comments by Pioneer Project Manager Charles F. Hall; Bob McCall, the stamp artist; James O'Malley, Postmaster, Mountain View; and William J. Sullivan, Regional Postmaster General. Reverend Harry L. Wooding, First Presbyterian Church, Mountain View, will give the invocation. The Mountain View High School Band, and the San Jose Chapter of Sweet Adelines, a singing group, will perform.

A full-scale model of the Pioneer spacecraft will be on display as well as other exhibits of the planet Jupiter. Stamp collecting materials, first day covers, and starter kits will be on sale.

Entry to Ames should be made at the NASA-Ames gate of Moffett Field.

-end-

The National Aeronautics
And Space Administration
Ames Research Center
Moffett Field, California 94035

For Release:
IMMEDIATELY

Larry King 415/965-5091

Release 75-3

WATER DETECTED AT JUPITER

AMES RESEARCH CENTER, Mountain View, Calif. --- Water vapor has been detected for the first time deep in the atmosphere of Jupiter.

The discovery was made from NASA's new C-141 Airborne Infrared Observatory, a large four-jet cargo aircraft fitted with a 91.5 centimeter (36 inch) infrared telescope. The Observatory is able to fly at high altitudes, above virtually all the water vapor in the earth's atmosphere which ordinarily masks infrared observations.

The aircraft is based at NASA's Ames Research Center at Moffett Field, California.

Water, which contains oxygen, one of the most common elements in the universe, had not been found before on Jupiter. The research effort was conducted by a four-man astronomy team from the University of Arizona's Lunar and Planetary Laboratory flying aboard the aircraft.

February 12, 1975

Robert Cameron, Ames Airborne Astronomy Programs Manager, said the detection of water at Jupiter is the first major discovery using the big new airborne telescope. "We expect many more important discoveries as we move into full operational status," he said.

The telescope is installed in an open cavity recessed into the port side of the aircraft immediately ahead of the wing. A principal advantage is that the telescope is used without an intervening optical window which would greatly reduce performance in infrared spectral regions beyond human vision range.

"The evolution of life as we know it on earth depends on the presence of water," says Dr. Harold Larson, University of Arizona Principal Investigator. "Water is a medium that permits other substances to combine and can also be an active participant in chemical reactions," he explains.

Although the data do not provide conclusive evidence that there is life on Jupiter, the discovery of water vapor "adds confidence" to speculation that organic compounds--precursors to life--are being formed in Jupiter's atmosphere and may account for the coloring (reds, browns and oranges) of its clouds.

"We have found this water down deep where it is hot, at about room temperature, and at less than 20 atmospheres pressure (20 times the pressure experiences at sea level on earth)," says Larson. "It is the first observation of its type probing that deeply into the atmosphere of Jupiter."

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Cameron pointed out that the new data complement the wealth of Jupiter information returned by the two recent flybys of the giant planet by Pioneer spacecraft. The C-141 observations were made using different wavelengths than were included in the Pioneer experiment package. "Our data, combined with the data from the Pioneer missions, totally add to the storehouse of knowledge about Jupiter," Cameron said.

Cameron said future research flights would continue to refine studies of Jupiter and Saturn, and during the coming year will look at the atmospheres of the planets Uranus and Neptune as well.

The University of Arizona astronomers, also including Dr. Uwe Fink, Dr. Richard Treffers and graduate student Thomas Gautier, used the NASA Airborne Infrared Observatory for their observations last October. Larson said that the flying observatory--a new, national facility--made possible the discovery because the equipment used is too bulky to be sent up in a spacecraft--the only other way of escaping earth's atmosphere.

The next step for the team, says Larson, is to use the new data to predict temperature, pressure and the amount of certain gases and thereby develop a structural model of Jupiter's astmosphere.

Other scientists, he predicts, will take the discovery of water vapor and use various laws of chemistry and physics to predict what Jupiter was like at the time of its formation and to see if, at its birth, it conformed with what currently is known about the origin and evolution of our solar system.

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NASA NEWS

The National Aeronautics And Space Administration
Ames Research Center
Moffett Field, California 94035

For Release:
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Release 75-11

Stan Miller 415/965-5091

Author of this release is Susan Baumgart, a journalism graduate student at San Jose State University, working at NASA under a 1975 science writing scholarship from the ARCS Foundation.

GALILEO II IN ARCTIC EXPERIMENTS

AMES RESEARCH CENTER, Mountain View, Calif. --- NASA's flying laboratory, "Galileo II," is leaving Ames Research Center for Alaska this week to participate in a month-long field investigation of the Arctic seas.

Increased concern for the ecology of northern waters is prompting scientists from the United States and Canada to cooperate in a series of experiments designed to improve understanding of the Arctic environment. Researchers from NASA, the U.S. Geological Survey, U.S. Army, U.S. Navy, National Oceanic and Atmospheric Administration, various research organizations, and several Canadian agencies hope to find suitable methods of measuring critical changes in that environment.

One of the primary missions, called AIDJEX for Arctic Ice Dynamics Joint Experiment, is to investigate the fundamentals of Arctic sea ice. The AIDJEX field experiment will measure ice motion, weather and ocean conditions to see how these variables interrelate. From the aircraft, scientists will obtain data on the sea ice so that when the information data is coupled with data provided by AIDJEX field parties on the ice the combined data can be used in interpretation of satellite pictures made at the same time.

Accurate environmental information on the Arctic is urgently needed, according to mission manager Earl Petersen. As yet, he points out, prediction of effects of activities like intensive fishing and oil recovery is inadequate so no one really knows how to best manage Arctic resources.

In addition, Petersen said, better understanding of the atmosphere-ice-ocean interplay will help recognize world climatic changes. By careful observation, man could even predict the onset of another Ice Age if one were to occur.

A second primary mission is to study marine mammals. This mission is called Bering Sea Marine Mammal Experiment (BESMEX) and its major goal is to understand the animals' migration pattern and to insure conservation of Bering Sea marine mammals. Scientists will look for relationships between mammal population, migration, and sea ice conditions.

The walrus and bowhead whale have been chosen as study species because they are the easiest to track by remote sensing and excellent background information on them already exists.

A third primary mission is to determine the microwave emission characteristics of polar ice. (Microwave is a term for very long wavelength energy, much longer than that of visible light.) By analyzing the different emissions of sea ice, scientists may find a key to monitoring global climate

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and to monitoring the size distribution of sea ice. The latter would have an ultimate application of developing an inexpensive means of predicting the survival rate of off-shore drilling rigs in the Arctic Basin.

The Galileo II, a Convair 990, is scheduled for these and other Arctic studies through April 1976. On-board instruments include microwave radiometers, imaging radar systems, laser profilometer, infrared radiometers, camera systems, and atmospheric sensors.

The first experiment to utilize the airborne laboratory is the marine mammal study. The initial set of flights will be out of Anchorage over the Bering Sea April 2 through 9. Then April 12 through 27 the aircraft will fly from Fairbanks to conduct studies over a camp of scientists on the ice north of Alaska and to obtain remote measurements of the ice to the North Pole.

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The National Aeronautics
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Ames Research Center
Moffett Field, California 94035

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Release 75-13

NOTE: This release should be read along with the attached Jupiter photo (last page). In addition to this lithographed version, glossy prints can be ordered from NASA-Ames, Mountain View, CA (415) 965-5091, or from News Audio-Visual, Code FP, NASA Headquarters (202) 755-8366.

PIONEER II PICTURE APPEARS TO SHOW HURRICANE-LIKE POLAR STORMS, BREAKUP OF JUPITER'S BANDS

A polar picture of Jupiter shows for the first time what appear to be hurricane-like storms in Jupiter's north polar region. The picture also gives the first detailed view of the breakup of Jupiter's alternating dark belts and bright zones as one goes toward the pole.

Since Jupiter's polar regions cannot be seen from Earth, and since the Pioneer II spacecraft, which took the picture, flew very close to the giant planet, the enlarged image shows many features never seen before.

The picture covers part of Jupiter's north temperate region, and its north polar region. The northernmost part of the picture shows areas within 17° of the North Pole.

1776 AMERICAN REVOLUTION BICENTENNIAL 1776-1976 1976

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According to Dr. Andrew Ingersoll, California Institute of Technology, the polar regions appear to contain an unorganized array of hurricane-like convective storms (white circular spots on photo). Many of these storms appear to be circular, and some are several hundred miles across. The storms probably are composed of many small convection cells (not visible in the picture, but something like Earth's cumulus clouds), and these storms may have high rotational velocities.

Going north toward the pole, the regular banded structure of Jupiter's clouds begins to fall apart. The alternating, planet-girdling orange belts and grey-white zones, the most prominent features on the planet, first appear to break down into swirling, scalloped and oval structures, and farther north to disappear completely.

Scientists believe that understanding of Jupiter's meteorology, and that of other planets, will be of major importance in the understanding of weather on Earth.

Pioneer II flew within 42,000 km (26,000 mi) of Jupiter last December. The polar picture was taken in blue light from 600,000 km (373,000 mi).

The Pioneer Project is managed by NASA's Ames Research Center, Mountain View, CA, and the Pioneer spacecraft were built by TRW Systems, Redondo Beach, CA.

The Jovian polar storms may be similar to the Earth's fast-spinning tropical hurricane because they are of similar size, and like hurricanes may well be "heat pumps," powered by the latent heat of condensation of water vapor and ammonia vapor. That is, a rising column of the hot, moist atmosphere, believed to be present on Jupiter, would get started, creating a low-pressure zone. More atmosphere would rush in and be sucked up by the rising column. As the column rises, it cools, condensing out the water vapor. Condensation produces a lot of heat which drives the column even higher. At the top of the column, the heat is released to space by radiation.

The Jovian rain, which would condense out as the storm rose, would then fall back to hot regions of the atmosphere and be revaporized to repeat the cycle and pump more heat upward.

Sharply defined spiral features and scallops, most of them at the boundaries of high-latitude belt and zone regions are believed to result from the wind shears between adjacent, counterflowing jet streams produced in the belts and zones, says Dr. Ingersoll.

Many of the jet streams producing these spiral features have speeds relative to the planet of 150 mph each, in opposite directions. This means 300 mph winds at these shear points.

Breakup toward the poles of Jupiter's bright zones of rising atmosphere and darker belts of falling atmosphere, with their accompanying jet streams, is not well understood, but is believed to occur, among other reasons, because there is virtually no solar heating at the poles and hence Jupiter's internal heat becomes dominant. Also, the effects of coriolis force on the fast-spinning planet are quite different at the equator than at the poles.

The circular motion which appears to be present in the polar storms may be a result of coriolis force. The tendency to circular motion of the atmosphere is greatest at the poles.

The white features in the picture generally show upwelling, while the dark areas show downward movement of the atmosphere.

Jupiter is a liquid planet and hence has no solid surface, nor any "oceans," only a gradual transition going downward, from atmosphere gas to liquid.

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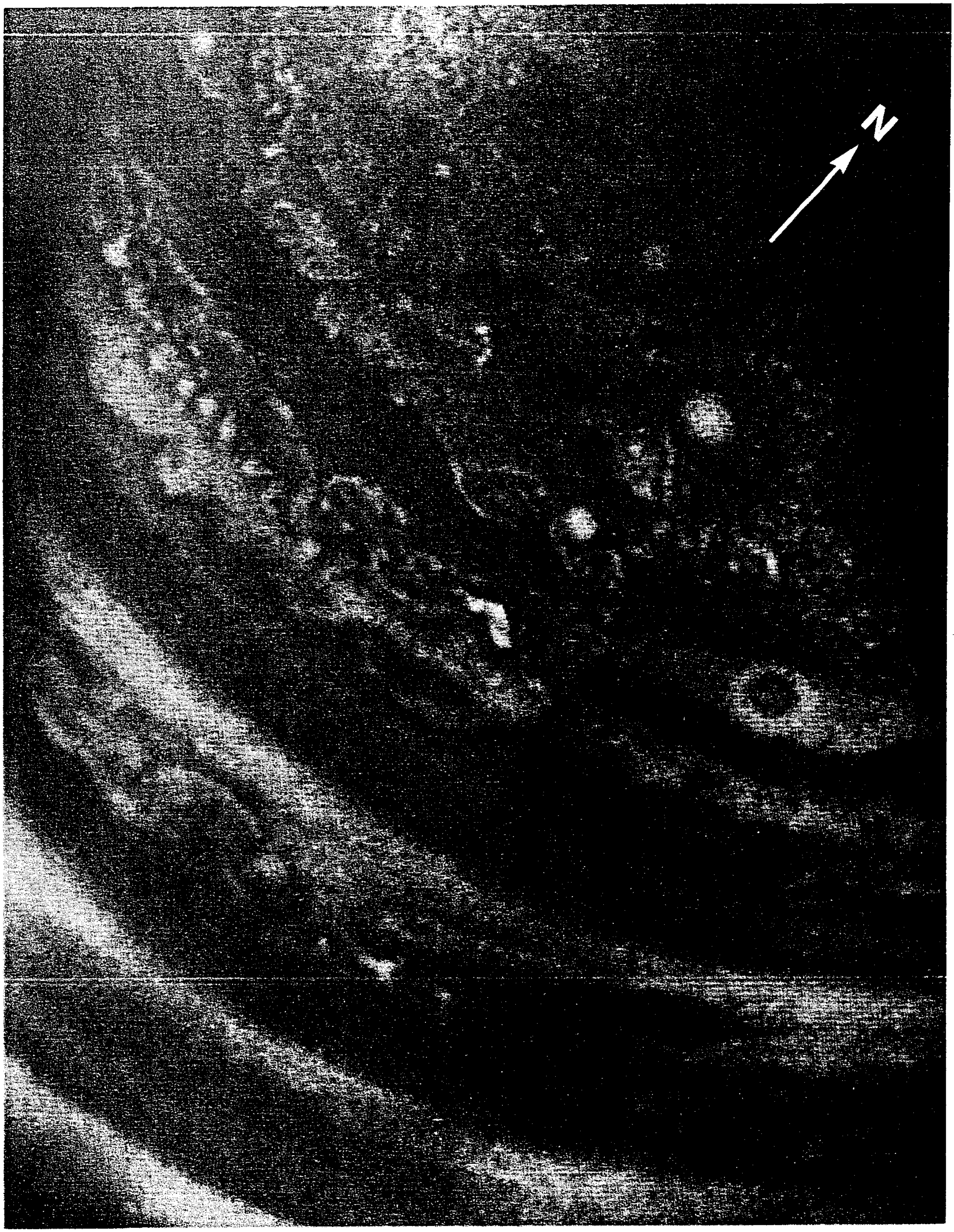
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NEWS

The National Aeronautics
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Ames Research Center
Moffett Field, California 94035

Stan Miller 415/965-5091

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June 16, 1975
Release 75-24

MARS, PLANETOID, EYED AS FUTURE HOME

AMES RESEARCH CENTER, Mountain View, Calif --- University and government scientists begin considering ideas this week to make an artificial planetoid or the planet Mars places where mankind could emigrate and colonize.

A ten week workshop at NASA's Ames Research Center involving some 25 resident and visiting experts will study the visionary concept of cities in space. The group will concentrate on reducing theory to engineering, social and economic considerations to see what really would be needed to send human colonies to new homes in space.

The problems in such an endeavor are staggering but maybe within the grasp of current technology, according to Dr. Richard Johnson of NASA and Professor William Verplank of Stanford University. And they say, it is time to make assessments like this, should mankind ever want, or need, to leave Earth.

The orbiting community concept, like the space habitat proposed by Dr. Gerard K. O'Neill of Princeton University who will aid in the study, proposes to use lunar or asteroidal raw materials in the construction of an artificial planetoid. The study will concentrate on how to utilize extraterrestrial materials, how to process them and how to transport them to the "construction site" in space.

One aspect of the planetoid as suggested by O'Neill is to use it to construct a collector for solar energy which would be converted to electricity and beamed by microwave to Earth. Such a source of energy for man's future needs would avoid the problems of traditional energy sources like coal, petroleum and nuclear reactions.

A separate study headed by Dr. Robert MacElroy of Ames will take a new scientific look at Mars. The Red Planet, more like Earth than any other, could be a target for human migration. The trick is to build a breatheable atmosphere in what is now an alien environment. It might be done, theorists say, in a matter of decades if we could create conditions where algae-like organisms using solar energy and photosynthesis to make oxygen as green plants do on Earth. These conditions may be possible if a way is found to irrigate the planet with water suspected to be in or under the soil.

The studies are hosted by Stanford University and the NASA Ames Research Center as an annual engineering systems design institute.

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May 29. 1975

NEWS
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Release 75-30

PIONEER 10 EXPERIENCES UNEXPLAINED ORIENTATION CHANGES

The Pioneer 10 spacecraft, halfway between the orbits of Jupiter and Saturn on its way out of the solar system, is making some small unexplained orientation changes.

The spacecraft's axis of rotation is changing position about 1/12 of a degree per day, or roughly 1° every two weeks in the same direction. Project officials say they don't know the reason for these changes in spacecraft orientation. They could be due either to a very slight malfunction or to some kind of interplanetary phenomenon. Evidence so far is contradictory. If the spacecraft, which rotates at 5 rpm, is moving from the force of a tiny gas leak in its attitude control system, then these tiny thrusts would have to be timed exactly--five times a minute--an unlikely condition. Magnetic field effects either from space, or on board the spacecraft have been largely ruled out. If Pioneer is encountering interplanetary dust between Jupiter and Saturn, radio tracking should show small changes (1/10 mph) in spacecraft speed, and speed changes have not been seen.

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Additional tests are now planned to find the cause of the attitude changes. Pioneer 10 now is 1,114,000,000 km (692 million miles) from the Sun and 1,200,000,000 km (745 million miles) from the Earth. The spacecraft is moving away from the Sun at 43,000 km/hr (27,000 mph).

Attitude changes at the present rate have been going on for three weeks, with smaller changes before that.

Pioneer 10 completed the first trip to Jupiter in December 1973, and will leave the solar system in 1978, when it crosses the orbit of Pluto.

- end -

NASA NEWS

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Release 75-41

NOTE TO EDITORS

The preliminary summary report of the ten-week NASA Ames-Stanford summer study of space colonization will be made on Friday, August 22 at Ames Research Center.

The study is conducted by 25 specialists, most of them professors of engineering, physics and social sciences from major U. S. universities.

An hour-long news conference from 8:30 to 9:30 a.m. will provide a brief summary of findings plus space colony visuals for television.

From 10:00 to 12:00 a.m. several speakers will present the summary report, with time for questions afterward.

A space colony cannot be designed in ten weeks, but the group has roughed out the general outlines of a first-phase, 10,000 inhabitant "city in space" to be built perhaps in the next 50 years. Two key concepts are that the environment would be similar to Earth's, and that there are several major economic advantages, which might allow the colony to pay for

August 12, 1975

itself. These are advantages of weightlessness for manufacturing and transportation, unlimited power from continuous undiffused sunlight, and use of lunar materials. Moon materials contain necessary metals and minerals, and are relatively easily available because of low lunar gravity.

The group took a hard look at engineering problems of construction, and also studied cultural, social, and ecological factors of a colony at lunar distance from Earth, at the point where Earth and Moon gravity balance.

A ten-page digest and visual materials describing the colony concept will be available. The group will issue a detailed final report in several months.

Those attending should come to the NASA gate of Moffett Field, and will be directed to the Space Sciences Auditorium, Bldg. 245.

- end -

August 12, 1975

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News

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For Release
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Release No. 75-53

PIONEER 11 TO TAKE FIRST LOOK AT SATURN

Pioneer 11, now making the first trip to Saturn, will take its first look at the ringed planet next Thursday morning, November 20. Pioneer made history's closest approach to Jupiter, the largest planet in the solar system, last December 3, coming within 41,000 km (26,000 miles) of the planet's cloudtops and traveling 171,000 km/hr (107,000 mph), the highest speed ever attained by a man-made object. The spacecraft returned the only pictures ever taken of Jupiter's polar regions, probed the planet's intense inner radiation belts for the first time, and made other discoveries.

During the Jupiter flyby, controllers at NASA's Ames Research Center, Mountain View, CA put Pioneer on a course which used Jupiter's huge gravity to throw the spacecraft across the solar system toward Saturn.

Pioneer is still over 800 million miles from Saturn, which it will reach in September 1979. This puts it just a little

- more -

November 14, 1975

closer to the planet than Saturn's distance from the Sun. However, the spacecraft currently is observing the spectacular ringed planet from an "off to the side" angle, 24 degrees to the right of the line between the planet and the sun. This position shows the planet at a "phase angle" four times larger than the largest angle at which Saturn can ever be seen from the Earth.

Scientists are interested in looking at planets from large phase angles (away from the sun-planet line) because the total amount of light and the polarization of the sunlight reflected from the planet's atmosphere at different angles tells something about the atmosphere. If the planet is very bright at a certain phase angle, this means its atmosphere must be composed of certain specific gases. Hence scientists want to watch Saturn throughout Pioneer's approach, watching the changing intensity of the planet's reflected light at changing phase angles, as well as changes in polarization of the light.

Lyn Doose, University of Arizona experimenter in charge of the Pioneer Saturn observations points out that the effect is like a rainbow.

"On Earth, if you see sunlight scattered from clouds at a certain angle, you get a sudden brightening, known as a rainbow. Planets seen from certain sun angles produce 'cloud bows'," Doose explains. "A cloud bow seen on Venus told us there was considerable sulphuric acid in the top of the atmosphere. Since Saturn is usually around a billion miles from Earth, we know very little about its atmosphere, and these high phase angles should tell us more. We may see a sudden brightening, or Saturn cloud bow, as Pioneer approaches.

The observations with the University of Arizona imaging photopolarimeter (the IPP) will begin at 8 a.m. on the 20th, and should last several hours. The picture-taking function of the instrument will not be used because the planet is still so far away that details cannot be seen, though light intensity and polarization can.

The IPP continues to work as well as it did before reaching Jupiter, despite intense radiation at the planet. The electronic camera system returned hundreds of pictures of brightly-striped Jupiter.

A regular series of observations of Saturn is expected to begin around next July. However, next Thursday's observations of the planet are intended to help determine just when such a program should begin.

Scientists are at least - interested in comparing the light-reflecting characteristics of Saturn's rings as they are in light from the planet itself. At the current viewing angle,

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large areas of shadow will be cast on the rings by the planet, another effect not visible from Earth.

Pioneers 10 and 11 are managed by NASA-Ames, and were built by TRW Systems. Pioneer 10, Pioneer 11's twin spacecraft, reached Jupiter in December 1973, and is now approaching the orbit of Saturn on a course that will take it out of the solar system. It will be the first man-made object to leave the solar system.

Besidesgoing to Saturn, Pioneer 11 currently is headed upward out of the plane containing the planets and will reach a distance of around 100 million miles above this plane in 1977, allowing it to measure phenomena coming from higher latitudes on the Sun than have ever been observed before.

- end -

November 14, 1975

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News

For Release
IMMEDIATE

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Release No. 75-65

PIONEER 6 MAY GO ON FOREVER

On Tuesday, Dec. 16, NASA's Pioneer 6 interplanetary spacecraft will have been circling the Sun and returning good data for ten years. This is believed to be the longest operating life ever attained by an interplanetary spacecraft.

Officials are delighted with this performance because Pioneer 6 design specifications called for a required life of at least six months.

Pioneer 6 made the first detailed measurements of the interplanetary medium, some spanning a half billion miles. The workhorse spacecraft has measured the Sun's corona, returned data on solar storms from the inaccessible, invisible side of the Sun, and measured a comet's tail. It has made discoveries about the Sun itself, the solar wind, solar cosmic rays, and the solar magnetic field, all three of which extend far beyond the orbit of Jupiter.

- more -

12/11/75

Pioneer 6 and its three sister spacecraft, Pioneers 7, 8, and 9, also years beyond their six-month design lives, make up a network of solar weather stations which circle the Sun, usually in locations millions of miles apart. All of the current Pioneers (Pioneers 6 through 11) are still operating, and were designed as rugged, relatively-simple, low-cost spacecraft.

Pioneer 6 was built by TRW Systems, and the Pioneers are managed by NASA's Ames Research Center, Mountain View, CA. Five of the six scientific instruments, and all other systems aboard Pioneer 6 continue to work well.

"Pioneer 6 is such a good spacecraft," comments Project Manager Charles F. (Charlie) Hall, "that we may get another ten years out of it."

Since launch in Dec. 1965, the 140-pound Pioneer has, like a tiny planet, circled the Sun almost 12 times, covering just over six billion miles. During its ten-year life, the spin-stabilized, solar-powered craft radioed back measurements 24-hours-a-day from all sides of the Sun. Because newer missions have required tracking time on the "big dish" antennas of NASA's Deep Space Network, Pioneer 6 has often been pushed aside. About half of the 50 billion data bits, it has sent, have been received on Earth. Data is then transmitted to Pioneer experimenters, to other space scientists, and to the "solar weather forecasters" of the National Oceanographic and Atmospheric Administration's Solar Disturbance Forecast Center at Boulder, Colorado.

At Boulder, measurements by the four Pioneers, whose positions on various sides of the Sun change constantly, are used to predict solar storms for about 1000 primary users. These include the Federal Aviation Agency, commercial airlines, power companies, communication (radio) companies, military organizations, and organizations doing surveying, navigation, and electronic prospecting.

Pioneer 6 is drum-shaped, about 35 inches high and 37 inches in diameter. Its sides are covered with solar cells and divided by a narrow circular band with openings from which four experiments and four orientation-and-timing sun sensors look out during the instrument's full-circle scans with spacecraft rotation.

Pioneer 6 has three booms 120° apart. It provides its own data-handling, temperature control, communications, and power system. It has more than 56,000 parts.

The six scientific instruments include a magnetometer (of which a key part has worn out) to measure the Sun's magnetic field, two solar wind instruments to measure the million-mile-an-hour "wind" of charged particles, constantly blowing out from the Sun, a radio instrument to measure large scale segments of the solar wind (between Earth and spacecraft), and two cosmic ray instruments to measure the very high energy particles, coming either from the Sun or the galaxy. A seventh celestial mechanics experiment has used the spacecraft itself to measure the Sun-Earth distance, planetary orbits, and relativity data. Since Pioneer gets no energy inputs, but is powered by its solar cells and stabilized by its frictionless 60 rpm spin it easily shows small gravity effects for these measurements.

Pioneer 6 helped to chart the solar wind and the twisting magnetic fields threading it, plus the twisted streams of high energy particles which follow the magnetic field out from the Sun. All these phenomena co-rotate with the Sun every 27 days. Masses of such data have allowed better understnading of the solar corona (from which the solar wind "boils off" into interplanetary space) and of the Sun itself. Pioneer measures little pieces of the Sun, that is the particles it throws off into space. Pioneer measurements also have provided new understanding of Earth's magnetosphere, which shields us from high energy particle radiation. When the spacecraft has passed behind the Sun, relative to Earth, studies of its radio signal passing through the solar corona added to knowledge of the corona, making an eighth experiment.

- more -

Pioneer 6, and the three other Sun-orbiting Pioneers can help predict solar storms when positioned behind the Sun, because they see events on the solar surface up to two weeks before they become visible from Earth, due to the Sun's 27-day rotation on its axis. Such "geomagnetic storms" may trigger Earth's long-term weather. They are caused by the huge bursts of solar wind which buffet and vastly distort the Earth's magnetic field for as long as a week. This in turn throws circuit breakers, causing power blackouts. It makes compass navigation and surveying impossible, and cuts off radio communications, especially to Europe.

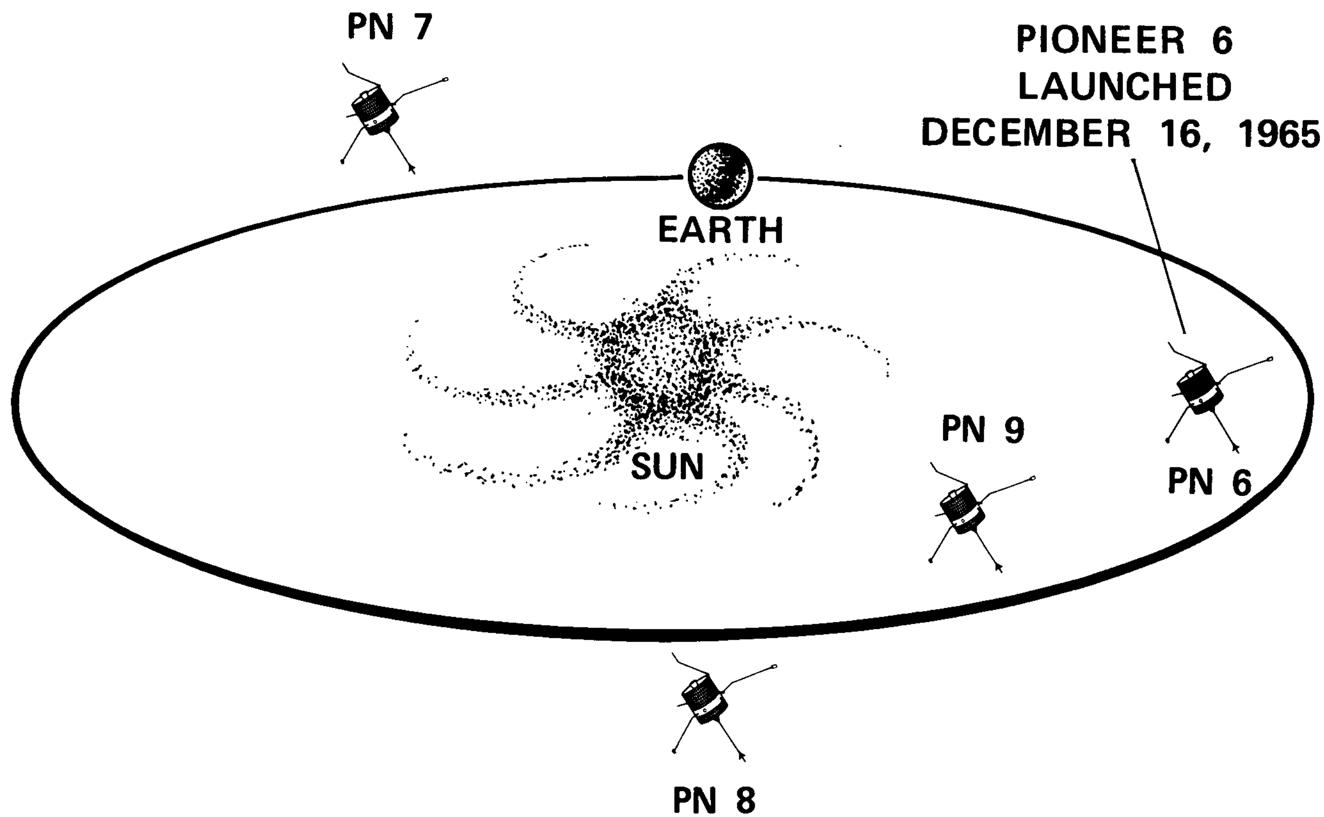
The longevity of Pioneer 6 allowed time for it to get behind the Sun and see the corona. It also allowed important studies of the same solar wind stream by two spacecraft, one millions of miles "down solar wind" from the other. In Nov. 1969, Pioneer 6, inside the Earth's orbit, and Pioneer 7, outside it, were aligned on the same solar wind streams and magnetic field lines. In Sept. 1970, a similar line up occurred with Pioneer 8. In August 1972, during the cataclysmic solar storm, when three huge solar flares were superimposed on each other, Pioneer 6 measured effects of the solar shock wave on its side on the Sun. In Dec. 1973, Pioneer 6 took a look at the tail of comet Kohoutek as it passed through the solar system. In March 1974 the venerable spacecraft measured solar phenomena in a fortuitous three spacecraft lineup. Pioneer 10 was

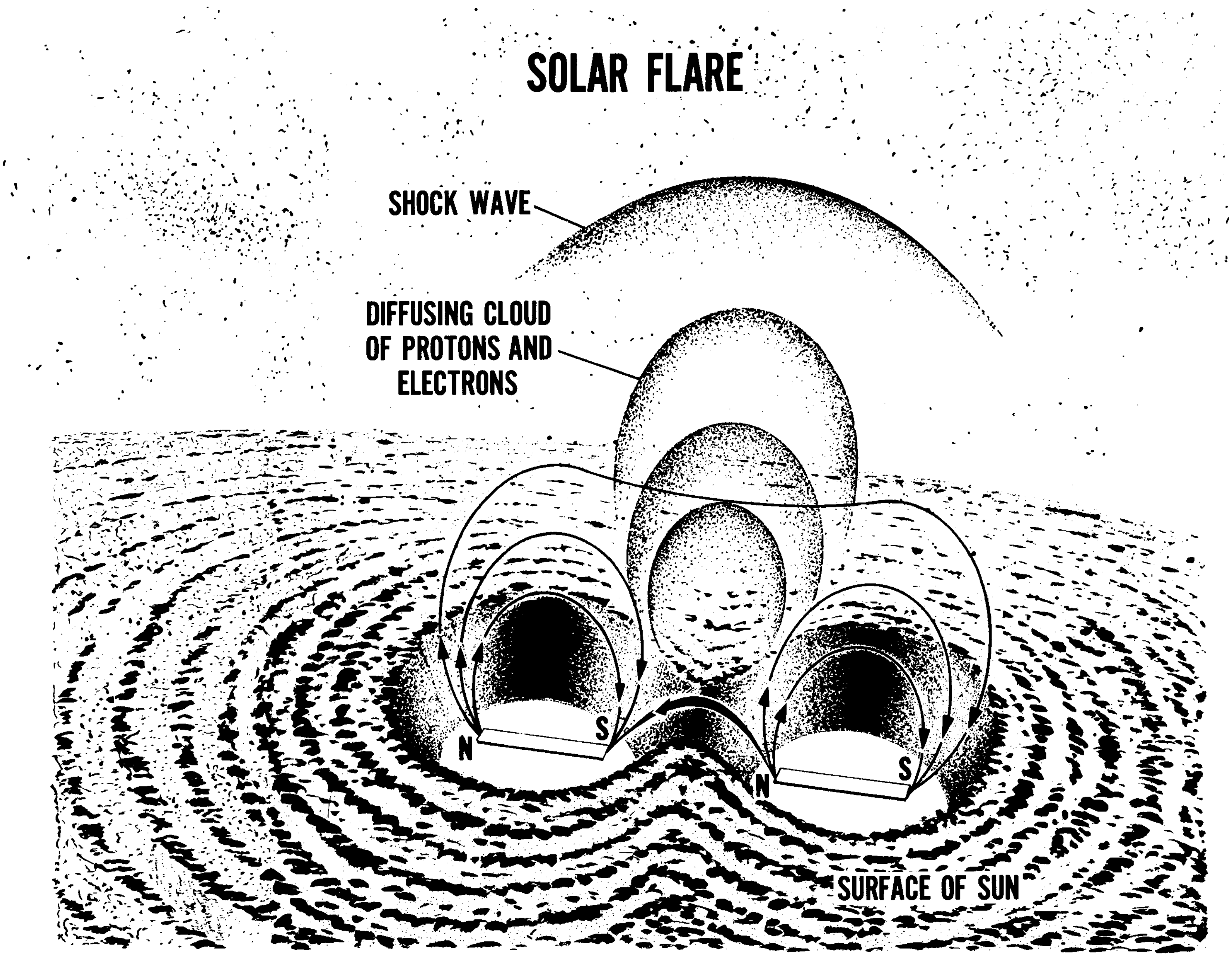
- more -

inside the Earth's orbit, while the much younger Jupiter and Saturn Pioneers (Pioneers 10 and 11) measured the same solar wind stream about 10 and 11 days later out near Jupiter almost a half billion miles away. In late 1974 and during 1975, three further measurements of this type were taken. In September of this year, because it had lived so long, Pioneer was able to team up with the new U. S.-German Helios satellite, which was six million miles inside the orbit of Mercury, closer to the Sun than any spacecraft has yet gone. This is completing the picture with measurements very close to the Sun, tied to a look at the same solar particles and fields near the Earth. These measurements are now being matched with the earlier looks at solar phenomena seen first by Pioneer 6 and later by Pioneers 10 and 11 far out near Jupiter.

- end -

PIONEER POSITIONS
DECEMBER 16, 1975

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DIFFUSING CLOUD OF PROTONS AND ELECTRONS
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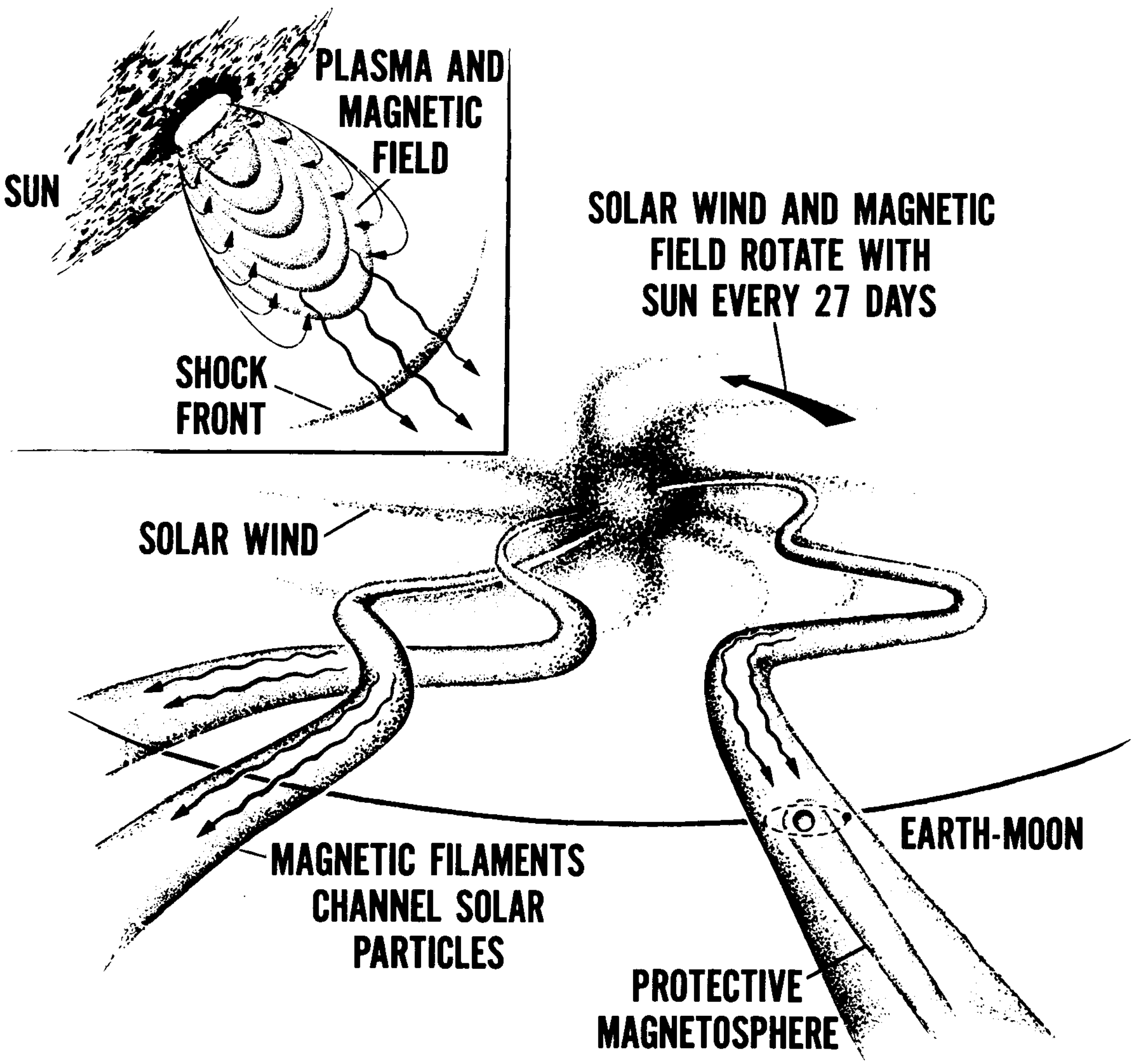
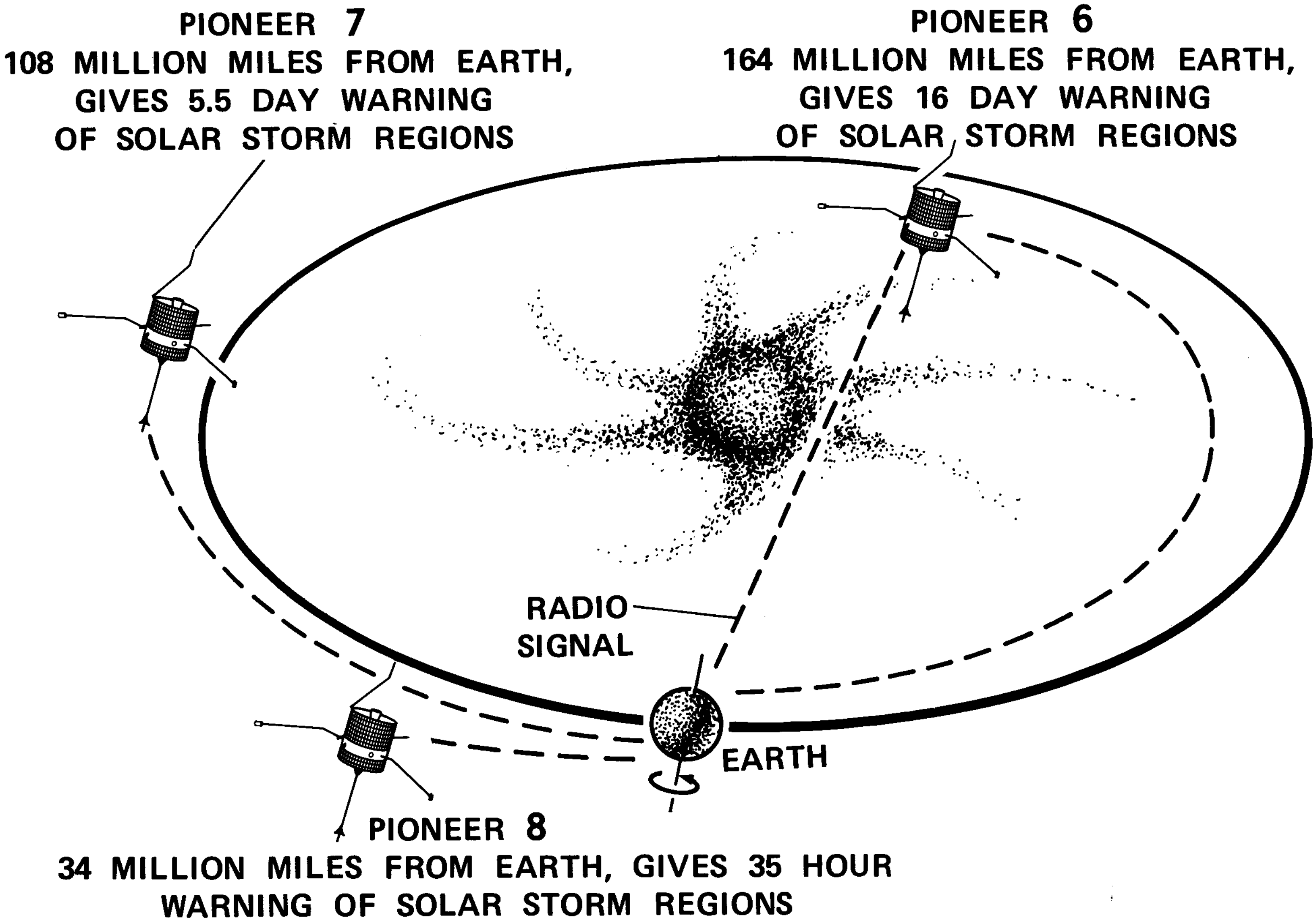
"WEATHER MAP" OF SOLAR SPACE



PIONEER 6, 7 AND 8

POSITION ON NOVEMBER 20, 1968 AS PIONEER 6
PASSES BEHIND THE SUN AND MEASURES CORONA



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News

For Release
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(415/493-9406)

Release No. 75-69

PIONEER TARGETED FOR SATURN

Pioneer-Saturn has successfully completed what officials considered its riskiest course-change maneuver, as it makes man's first trip to the ringed planet Saturn.

Controllers increased spacecraft velocity by 108 km/hr (67 mph) to make sure Pioneer has its two best options at Saturn--to fly between Saturn's rings and the planet, or to come in under the rings and then pass upward outside of them.

To do this, controllers had to cut off communication with Pioneer, which was 462 million km (287 million miles) from Earth, for several hours, and allow the spacecraft to command itself to change position, fire its thrusters, and then reposition itself to point its antenna back at the Earth, in order to resume communications. This is the only maneuver during which controllers have cut off communication with the spacecraft.

Pioneer 11 will take the first close-up pictures of Saturn and its brightly-lit rings, when it reaches there in 1979. It flew past Jupiter last December, making the first pictures of the

- more -

December 19, 1975

planet's polar regions, and recent picture-taking has shown that its electronic camera is working well. Its current trip from Jupiter to Saturn spans one and a quarter billion miles across the solar system.

During the Jupiter fly-by, Pioneer traveled faster than any man-made object has flown--172,000 km/hr (107,000 mph)--and it is still traveling about 65,000 km/hr (40,000 mph) due to the boost in velocity from giant Jupiter's gravity and orbital motion. Because of this high speed, Pioneer already has covered a third of the distance between Jupiter and Saturn (some 650 million km, 400 million miles).

If officials and scientists decide on the route inside Saturn's rings, Pioneer should also get a close look at Titan, Saturn's sixth moon. Titan is larger than the planet Mercury, and is one of the best candidates in the solar system for having life.

Risk of the recent mid-course maneuver was that if problems developed while the spacecraft (and hence its high-power, narrow-beam antenna) were turned 25^0 away from the Earth, controllers would have had no radioed information from the spacecraft about what it was doing. They could send commands to the spacecraft to correct any problem, but these would have had to be guesses. A series of such contingency commands was prepared. Though Pioneer-Saturn is very reliable, the operations of firing thrusters and making position maneuvers without communications on spacecraft status could cause difficulties.

"We are highly pleased with the operation," commented Project Manager Charles F. Hall of NASA's Ames Research Center, Mountain View, CA, which manages the Pioneers.

There will be several less-difficult mid-course maneuvers over the next three years. Four months of tracking will be needed to find exact effects of the velocity change on Pioneer's trajectory to Saturn. But probabilities are very high that the target change was very accurate.

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December 19, 1975

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News

For Release
IMMEDIATE

Stan Miller 415/965-5091

Release No. 76-01

Author of this release is Susan Baumgart, a journalism graduate student at San Jose State University, working at NASA under a 1975 Science Writing Scholarship from the ARCS Foundation

POTENTIALLY TOXIC SUBSTANCES IN DRINKING WATER DETECTED MORE EFFICIENTLY

NASA's Ames Research Center scientist Ben Tyson is refining a method of detecting, in drinking water, chemicals which the Environmental Protection Agency (EPA) is investigating as possibly harmful to human health.

In a recent survey, the EPA analyzed drinking water from 80 American cities for six compounds, all of which are familiar to chemists as substances one must handle with caution in the laboratory. Carbon tetrachloride, a commonly used cleaning compound, was found in the water supplies of 10 cities, and chloroform, sometimes used as an anesthetic, in 80.

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Chloroform and a number of other compounds are byproducts of chlorination, a process which authorities assert is the single most effective method of preventing typhoid, cholera, dysentery and other waterborne deseases. The EPA believes the benefits of chlorination far outweigh potential health risks from chlorine-derived compounds. But, as yet, the toxicity of these compounds has not been defined; the EPA is investigating the toxicity of these compounds.

To detect these compounds, they are first separated from the water, applying a technique originally developed as a method of finding evidence of life in planetary atmospheres.

Next, individual substances are separated by a laboratory technique already in common use. Both phases of the analysis utilize gas chromatographs.

The principle of gas chromatography is similar to that of rolling balls with different friction properties down a chute: they string separately according to their respective velocities. One can learn the characteristic time that a "tennis ball" or a "marble" takes to complete the run and then identify which is which by elapsed time instead of visual evaluation. In the chromatograph, the measurements apply to molecules which correspond to the rolling balls.

 January 14, 1976

The first chromatograph utilizes this process to separate water from the substances to be analyzed. Water takes significantly longer to pass through the chromatograph. The organic compounds are collected before the water exits and by switching a valve they are sent through the second chromatograph without the water. As they exit the second instrument, they are detected and recorded electronically. If the scientist finds, for instance, a signal at 658 seconds, he knows carbon tetrachloride is present.

The entire process takes about an hour, which is one-half to one-third the time required for other methods. Substances amounting to only a tenth-of-a-part per billion can be detected -- a tenfold increase in sensitivity. The method is broadly applicable to the analysis of many organic compounds.

Ames is preparing an instrument package for incorporation into an automated water monitoring system under development at the Johnson Space Center in Houston and supported by the NASA Office of Applications. This system includes the necessary sensors and sample collection, data acquisition and display subsystems required to monitor the effluent discharged from waste water treatment plants, as well as the input to drinking water supply plants. The Ames halogenated hydrocarbon

- more - January 14, 1976

detection method, in combination with other NASA developed sensor technologies, will provide a unique water quality monitoring capability heretofore unavailable to the user community.

Tyson has been working on this experimental process since July, using a pair of gas chromatographs and supporting equipment in his laboratory. The construction of a working automated instrument package began in late 1975. The target is completion of the project and shipment of the final instrument to the Johnson Space Center in June 1976.

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News

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Release No. 76-04

PIONEER 10 CROSSES SATURN'S ORBIT
ON ITS WAY OUT OF THE SOLAR SYSTEM

Pioneer 10, on its way out of the solar system, will cross the orbit of Saturn on Tuesday, February 10.

Pioneer 10 is making history's first trip out of the solar system and will leave man's home planetary system altogether when it crosses the orbit of Pluto in 1987.

Pioneer 10's sister spacecraft, Pioneer 11, is now making the first trip to Saturn itself (the planet, not its orbit), and will reach there in September 1979.

Pioneer 10, during the first part of its mission, completed the first trip to Jupiter in December 1973. Pioneer 10 carries a message to any intelligent beings which might retrieve it in millions of years. Scientists calculate that as it wanders through the galaxy, Pioneer will encounter a star system (solar system)

- more -

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about once every million years. The vacuum of space should preserve the spacecraft in good condition, though its nuclear power source will die completely in a few decades.

The Pioneers are managed by NASA's Ames Research Center, Mountain View, CA.

The sensitive "big dish" antennas of NASA's Deep Space Network will be able to hear Pioneer 10 as far out as the orbit of Uranus, 3.2 billion km (two billion miles) from Earth. It will reach Uranus' orbit in 1979.

Project officials say communication may be possible well beyond Uranus.

All systems aboard the 570 pound spacecraft continue to work well, and Pioneer is returning valuable data about the character of the interplanetary medium (the Sun's atmosphere) from the unexplored space out beyond the orbit of Jupiter.

It also is studying the interstellar medium, gradients of cosmic rays from the galaxy, and ratios of elements in interstellar space. Scientists use this data to try to determine the origin of the universe.

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On the February 10 orbit-crossing date, Saturn will be about 100 degrees around its orbit from Pioneer 10. Pioneer at the crossing point will actually be 130 million km (80 million miles) above Saturn's orbit. Since one Saturn year is 30 Earth years, the ringed planet will not return to the point where Pioneer's flight path intersects its orbit until 1999. Saturn was last at the intersection point in mid-June 1969.

As it crosses Saturn's orbit, Pioneer will be 1,384,600,000 km (860 million miles) from the Sun and 1,435,807,000 km (892,210,000 miles) from Earth.

- end -

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News

Peter Waller 415/965-5091

For Release

February 17, 1976

Release 76-07

SATELLITE SYSTEM TO WARN OF FOREST FIRE DANGER

Those who fight to prevent and control forest fires will get an assist from space this year as a new satellite-linked monitoring system begins a constant watch on thousands of square miles of precious California forests.

Some 23 NASA-designed ground stations will monitor forest conditions throughout California's important Region One forest area, providing data every three hours to foresters in Sacramento through a geostationary weather satellite.

The Region One forest area, which contains most of California's redwood forest and a large part of the state's timber resources, extends from the Oregon border to the San Francisco Bay and from the Pacific Ocean inland to the Coast Range Mountains.

NASA's Ames Research Center in Mountain View, California, developed the compact, self-powered stations in cooperation with the State of California's Division of Forestry (CDF). Part of the network will be operating during the 1976 forest fire season; the remainder will be completed in time for the

-more-

1977 season.

The 200-pound ground stations, powered by solar and wind energy combined with storage batteries, will provide continuous reports on wind speed and direction, air temperature, new solar radiation, relative humidity, and the moisture content of such flammable forest litter as pine needles and grass.

Sensors to measure rainfall and air pollution--including particulate matter and ozone concentrations--may also be added to the forest monitors.

Once every three hours, data from the automatic stations will be relayed through Synchronous Meteorological Satellite 2, which is in constant view of the area from its vantage point over the equator.

The satellite, operated by the National Oceanic and Atmospheric Administration (NOAA), sends the data to a NOAA receiving station at Wallops, Virginia, which automatically relays data to NOAA computers at Suitland, Maryland. The NOAA computers process the data and forward it to the U.S. Geological Survey (USGS) computer facility in Reston, Virginia, which sends it overland to USGS offices in California. Ames Research Center and the California Div i sion of Forestry obtain access to the data from the nearby USGS facilities.

Once the system is in operation, the complex processing and relay of the data will require less than 90 minutes from the time the automatic monitors record information on conditions in remote forest areas until foresters receive the data in Sacramento.

The new system is an experiment that may help reduce annual losses from forest fires in California, and it may also help cut the annual bill to fight fires in the state.

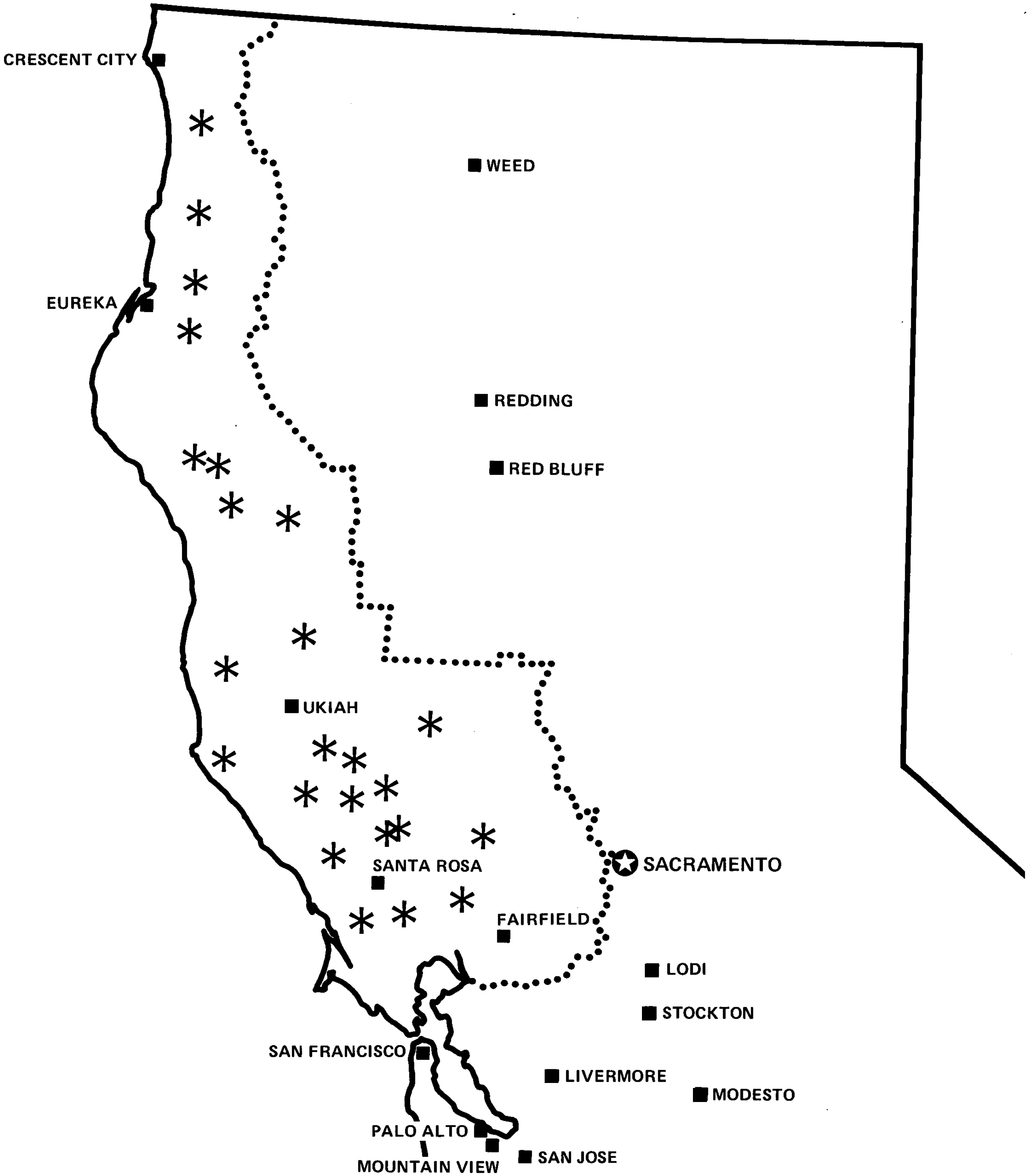
Foresters will use the continuous data on weather conditions to identify areas where the fire hazard is greatest, deploy fire-fighting teams to counteract the threat, and plan strategy to battle any fires that develop.

Experts say that knowing where fires are probable and how they might act is almost as important as having men and equipment to fight them.

Two prototype monitoring stations, designed and developed by Ames on the recommendations of the CDF, have been operating successfully at Sunol and Mount Zion, California, during a two-year test of their reliability and accuracy. The prototype instruments were sponsored by NASA's Technology Utilization program.

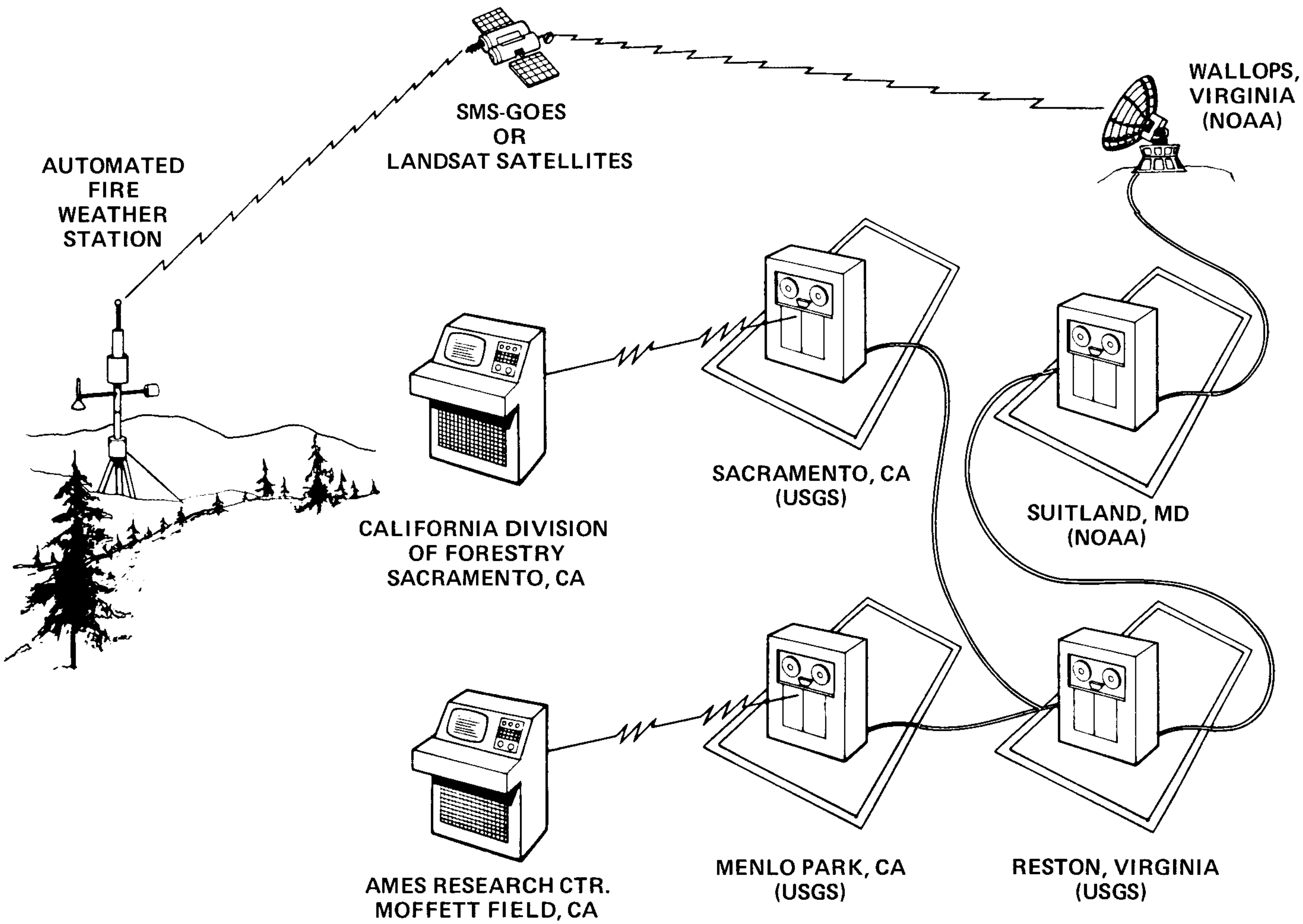
The new monitoring stations are low in cost, easy to assemble and require little maintenance. Three people can transport the 200-pound stations to even the most remote forest areas where only an hour is required to set them up. The stations are expected to operate for one year without maintenance, and designers are working on improvements that would permit two years of maintenance-free operation.

\- end - February 17, 1976



CALIFORNIA DIVISION OF FORESTRY
REGION 1
FOREST MONITORING SITES

SATELLITE FOREST MONITORING



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News

Peter Waller 415/965-5091

For Release
Tuesday
March 2, 1976
11:00 a.m.

Release No. 76-12

EDITOR'S NOTE: *This story is being released jointly by NASA-Ames and the University of California, San Francisco.*

BASIC DISCOVERIES RESULT FROM FIND OF NEW KIND OF PHOTOSYNTHESIS

A team of scientists at the University of California, San Francisco (UCSF) and NASA's Ames Research Center is working on a newly-discovered bacterial system for converting sunlight into chemical energy and food. This is the first time a photochemical mechanism other than chlorophyll-based photosynthesis has been found in a living organism.

Discoverer of the system is Dr. Walther Stoeckenius, UCSF. Various further discoveries about the bacterial system have been made by Drs. Richard Lozier, Roberto Bogomolni, and Janos Lanyi, working at Ames. Project grants came from NASA and the National Heart and Lung Institute.

Because the new-found biological system is relatively simple, the work provides important new understanding of several plant and animal cell functions and may have applications to medicine and agriculture. It also may apply to the generation of solar power, and to possible new "biological" industrial processes, such as desalination of sea water.

- more -

The transformation of light into energy forms capable of sustaining life is called photosynthesis. It is the ultimate energy source for plant and animal life on Earth, and is the basis of agriculture. It is also the most efficient large-scale method known of getting energy from the Sun. The new photosynthetic process is based on a purple pigment instead of a green one. The purple pigment is a protein molecule, called bacteriorhodopsin, which is chemically similar to the visual-purple pigment in the eye. The bacteriorhodopsin was discovered in the cell membrane of the bacterium, Halobacterium halobium, which lives in near-saturated salt solutions.

New insights into basic life processes, resulting from work on the new photosynthetic material, include:

1- The discovery that a single protein molecule, bacteriorhodopsin, functions as a light-driven pump for hydrogen ions (protons). Since protons are electrically charged, this pump converts solar energy into electrical energy.

2- Discovery of a new way of providing the energy to make ATP, the energy-storing molecule in all living cells. Other important ATP-producing processes are chlorophyll-dependent photosynthesis and the oxidation of nutrients within cells.

3- Mapping the three-dimensional structure of this complex protein molecule. This is one of the few protein molecules for which the three dimensional structure is known and the only membrane protein for which it is known at high resolution.

4- A better understanding of how nutrients from dilute solutions outside the cells are concentrated and transported into the cell interior, utilizing electrical and chemical gradients generated across the cell membrane.

5- An improved understanding of the function and structure of cellular membranes.

The discoverer of the process Dr. Walther Stoeckenius, UCSF, found the purple pigment in the bacterium while at Rockefeller University. On moving to UCSF, he and coworkers identified chemically the pigment and found that when illuminated it ejected protons to the surrounding liquid medium. He and UCSF coworkers and Dr. Efraim Racker, Cornell University, made microscopic artificial vesicles containing the purple pigment and demonstrated light-driven proton pumping from the vesicle exterior to the interior. They also found that by adding the ATP-producing enzyme, ATPase, to the vesicles, the electrical proton gradient generated by light across the vesicle membrane could be coupled to make ATP (energy-storage) molecules. This ATP production is thought to proceed in a way similar to that occurring in plant cells, which use proton gradients generated by the chlorophyll-containing photosynthetic system, and in animal cells that use proton gradients generated by oxidation of nutrients.

Dr. Richard Lozier and Dr. Roberto Bogomolni, working at Ames, have learned that the bacteriorhodopsin molecule operates as a proton pump by undergoing a cyclic photochemical process which involves at least five intermediate steps. In one of such steps a proton is ejected by the pigment to one side of the membrane and in a later step a proton is captured from the other side resulting in a net pumping effect. Each molecule can pump 250 protons per second across the membrane. (One bacteriorhodopsin molecule is 25,000 times larger than a proton.) The researchers have studied the function of the proton pump in the living bacterium and measured the efficiency of the process under physiological conditions.

Dr. Janos Lanyi of Ames, and Dr. Russell E. Mac Donald, Cornell, have found how the bacterium transports nutrients into itself, showing that this process is similar to that for other types of cells, but is energized by light absorbed by bacteriorhodopsin. This work helps substantiate one of two theories for accumulation and transport of nutrients into cells.

The Ames work is part of studies of earth organisms which live in extreme environments such as those expected on other planets. This study provides clues to the nature of life in such environments.

- end -

March 2, 1976

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For Release:

NOTE TO EDITORS:

The attached diagrams illustrate our release no. 76-12 on discovery of a new kind of photosynthesis. They were not ready at the time of mailing and are sent now because of the unusual interest of this story.

The illustration labeled Figure 1 shows a three-dimensional model of a single bacteriorhodopsin (purple pigment) molecule. Figure 2 shows distribution of the molecules in the purple membrane.

Release date of all material on this is Mar. 2, 11:00 a.m. PST.

Figure 1.

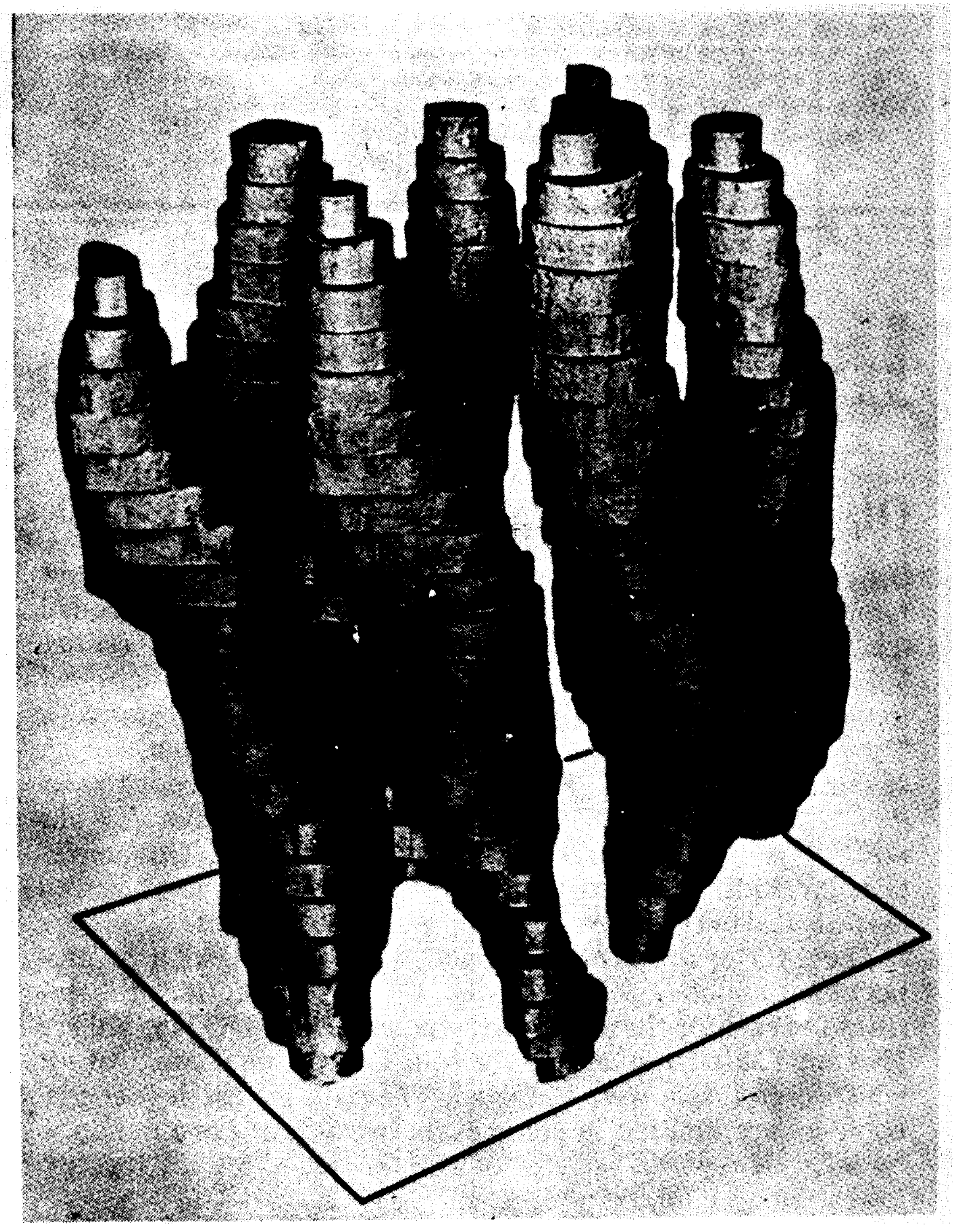
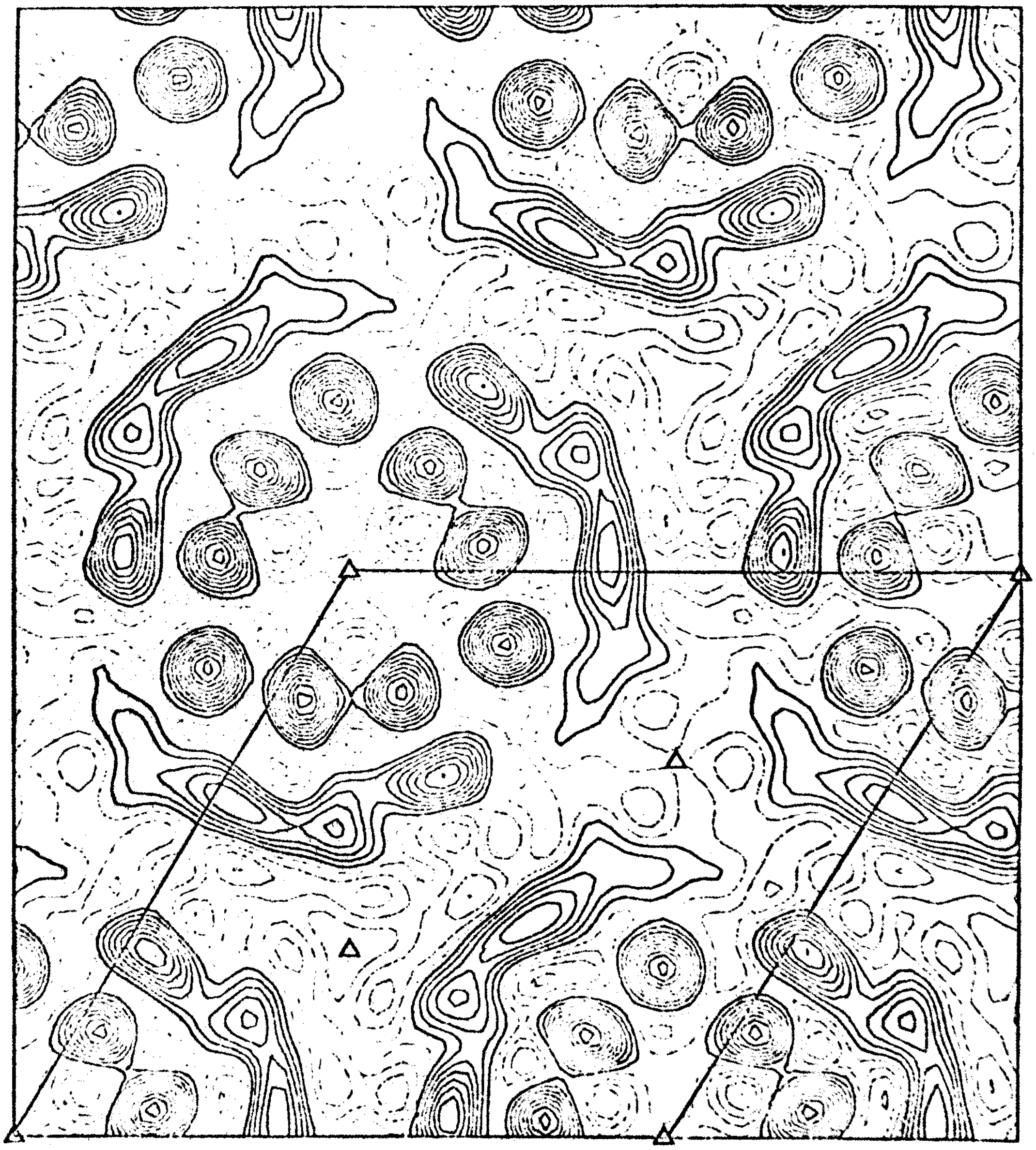
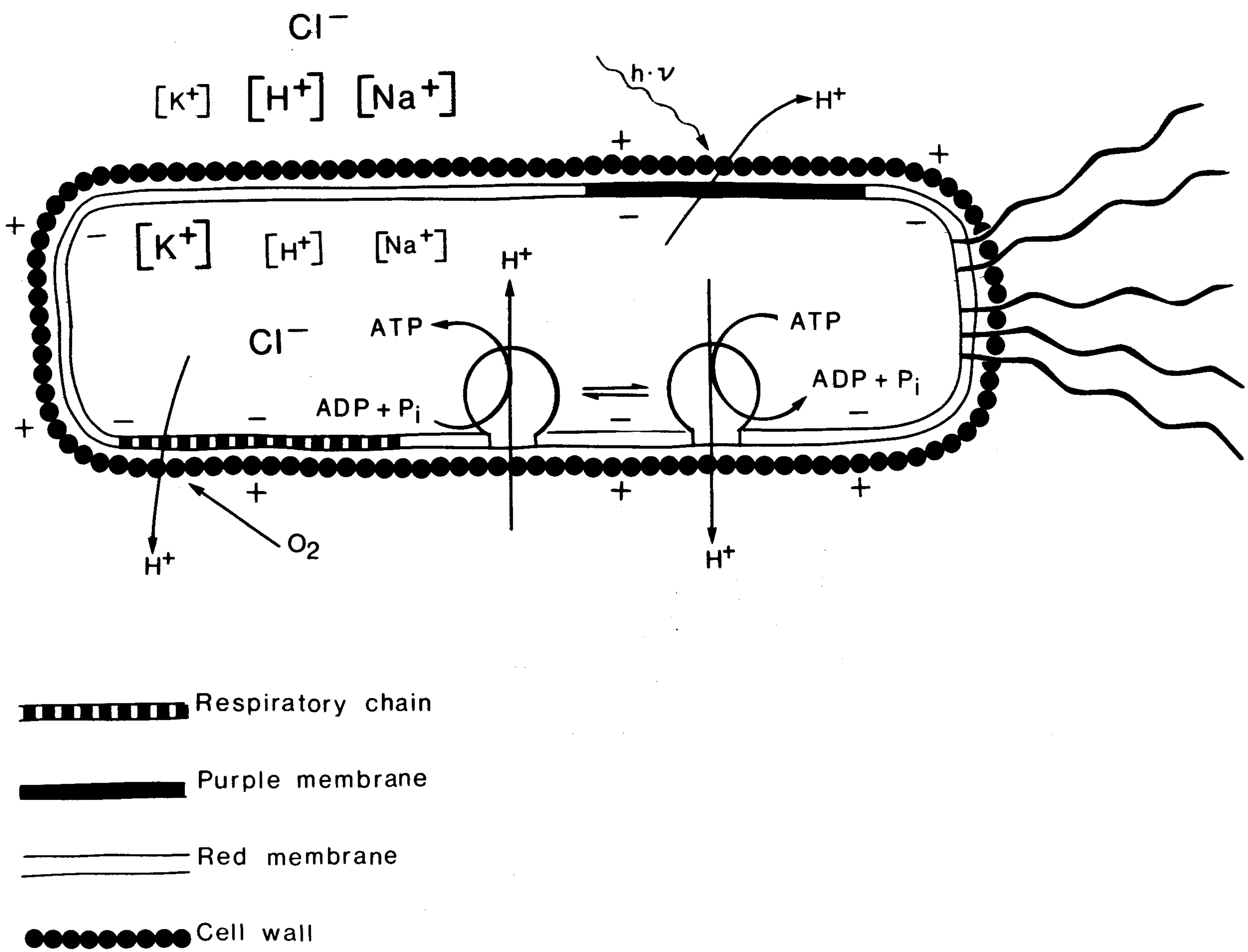


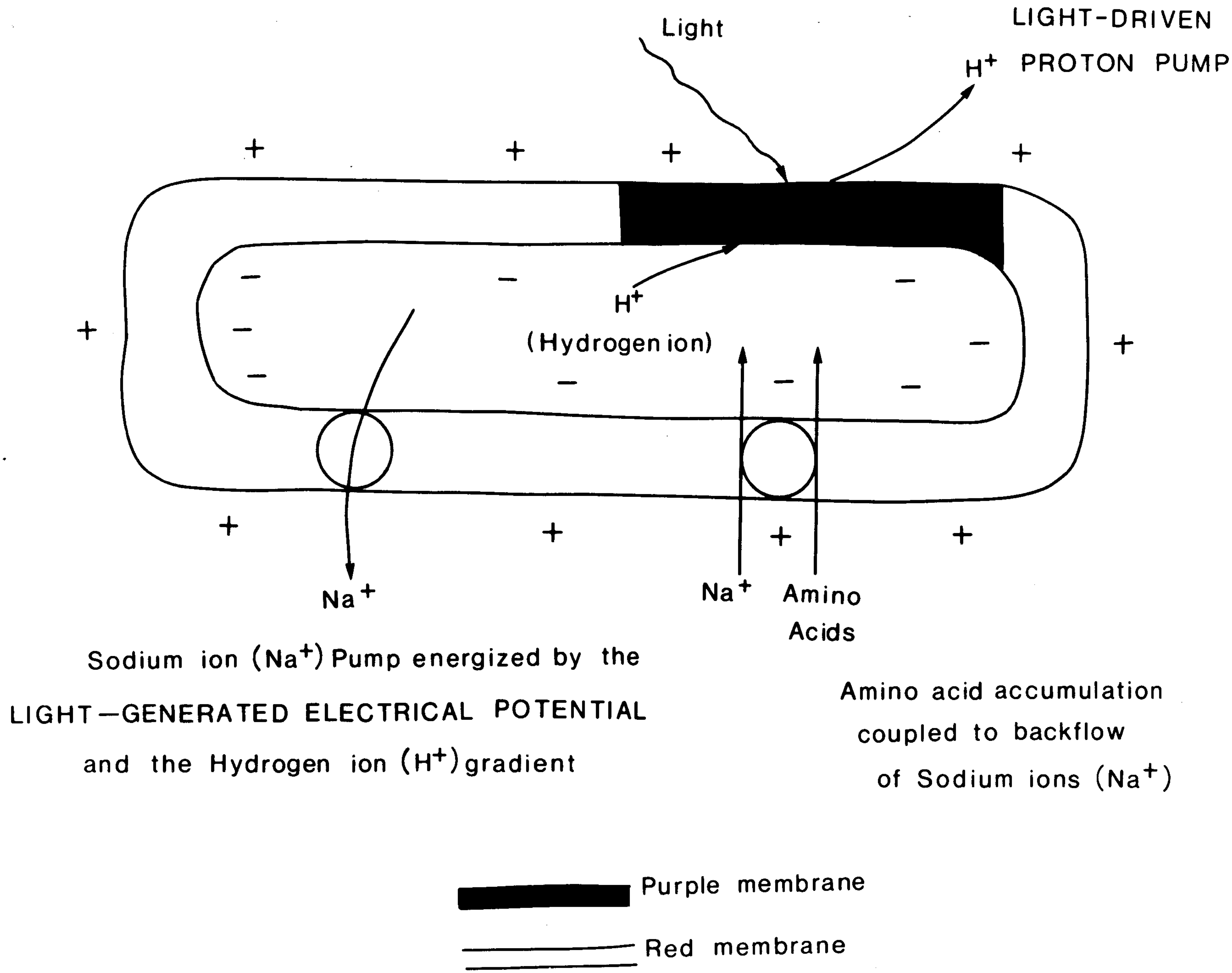
Figure 2.



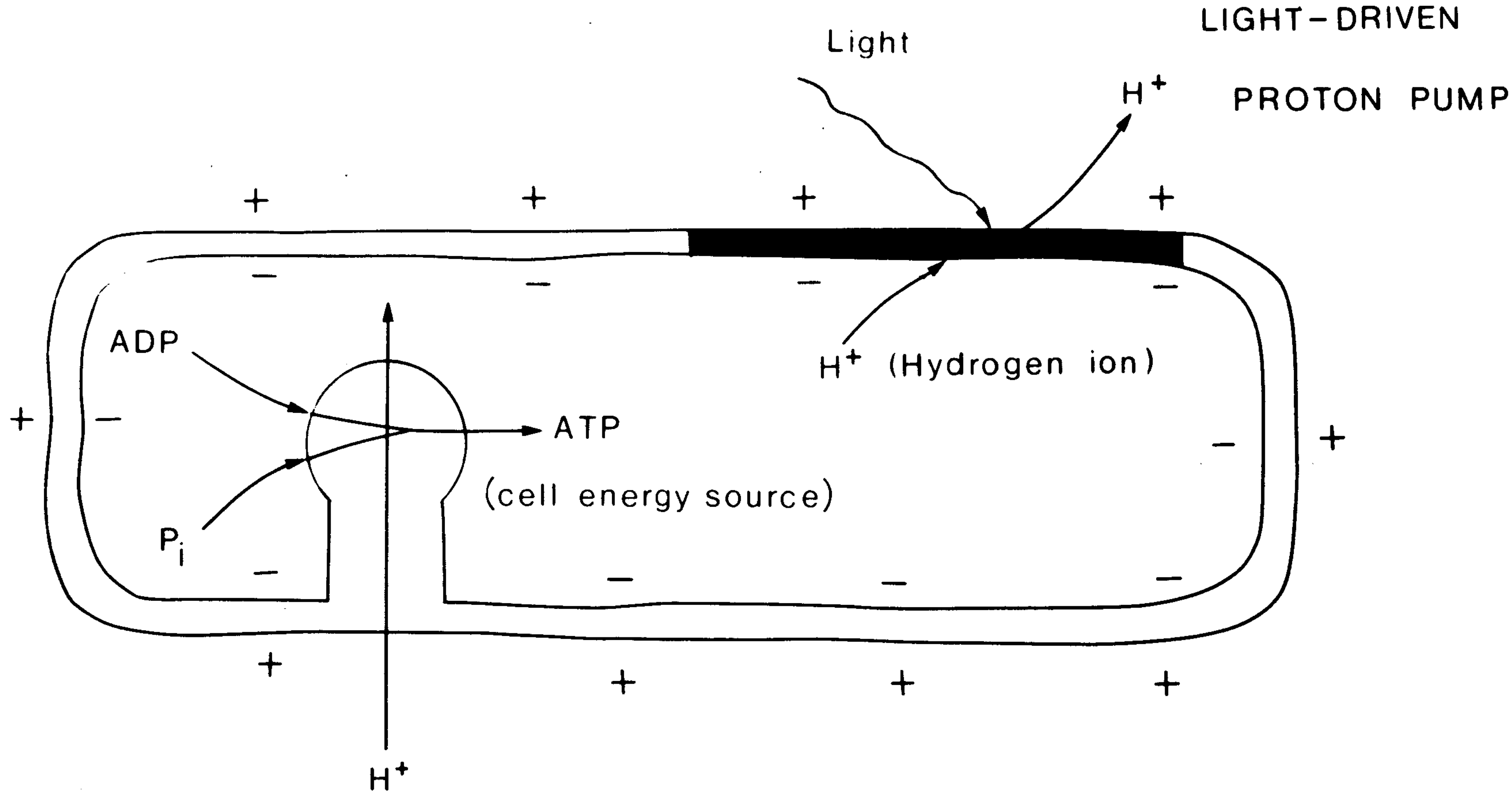
Structure and Energy Metabolism of *Halobacterium halobium*



Cell Nutrient Transport by Light Energy



Light Energy Makes Cell Energy Source (ATP)



Synthesis of ATP energized by the
LIGHT-GENERATED ELECTRICAL POTENTIAL
and the Hydrogen ion (H^+) gradient across the membrane

Purple membrane

Red membrane

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News

Peter Waller 415/965-5091

NOTE TO EDITORS:

A joint news conference by NASA's Ames Research Center and the University of California, San Francisco (UCSF) will be held at 11:00 a.m., Tuesday, March 2, at Surge Research Building, UCSF.

A team of scientists at UCSF and NASA-Ames has discovered a new kind of photosynthesis, a bacterial system using purple pigment rather than green for converting sunlight into chemical energy and food. Photosynthesis is the ultimate energy source for all life on Earth, and this is the first discovery of a system (other than the chlorophyll-based one) in which cells use light energy to survive.

Applications of the discovery are: the purple pigment appears to increase the evaporation rate of salt and may help with desalination of sea water. It also resembles rhodopsin, the little-understood visual pigment of the eye and may help explain the process and evolution of vision.

The workings of the proton (hydrogen ion) pump and purple pigment may help explain the key process of ion transport in all cells. The bacteria used in this research come from salt flats around the Mediterranean, have been known for 100 years, cause salted fish to develop pink eye and red herring to become red.

News conference participants are: Dr. Walter Stoeckenius, UCSF; Richard J. Havel, MD, Director of the Cardiovascular Research Institute, UCSF; Dr. Harold P. Klein, Director of Life Sciences, NASA-Ames; Drs. Richard Lozier and Roberto Bogomolni, UCSF, working at Ames; and Dr. Janos Lanyi, Ames.

Those attending should drive into the "emergency" entrance off Parnassus Avenue, identify themselves to the guard at the toll booth, go uphill to the research laboratories, and turn left into the parking area. Building sign says Surge.

There will be samples of the red-purple bacteria, lab equipment, large, colored charts, and other visuals for television.

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For Release:
IMMEDIATE

Release No. 76-22

DISCOVERY OF HUGE JUPITER MAGNETIC TAIL

Pioneer 10 has discovered that Jupiter has an enormous magnetic tail, almost half a billion miles long, completely spanning the distance between the orbits of Jupiter and Saturn (see drawing).

Pioneer 10 is on its way out of the solar system and crossed the orbit of Saturn in early February. Spacecraft sampling data shows that Pioneer was solidly in Jupiter's tail for at least 24 hours at the weekend, with five-hour time periods of no tracking before and after when it may have been in the tail, and periods of being partially in the tail before and after this, says Dr. John Wolfe of NASA's Ames Research Center, Mountain View, California. Ames manages the Pioneers. Dr. Wolfe is Pioneer project scientist.

March 22 1976

During the 24 hours in the tail the spacecraft solar wind instrument registered zero because the tail's magnetic envelope structure shut out the solar wind completely. Calculations show that Pioneer was in the proper position to intercept the tail, about one degree to the right of the Sun-Jupiter line. This bias is due to Jupiter's orbital velocity

"It is just barely conceivable that the solar wind could have died completely for a whole day without our being in the tail, and we'll know more when we have complete tracking data," said Dr. Wolfe, "but we believe we've found that Jupiter has a very stretched out magnetic envelope or tail (see drawing).

Scientists had speculated that Pioneer might be in a "magnetic bubble" broken off from the tail, but Wolfe now believes that because of the long time of zero solar wind, Jupiter has an intact tail stretching all the way from Jupiter to Saturn.

"The cylindrical tail may expand as it goes out," Wolfe says. "It may be even larger than the nine-million-mile diameter of Jupiter's magnetic envelope at the planet because the solar wind density is down four times by the time you're out to Saturn's orbit," he says.

The discovery means that Saturn itself should enter Jupiter's tail once every 20 years, next in April 1981.

This should produce some interesting magnetic phenomena, Wolfe comments.

The discovery means that almost two and a half years after its swing around Jupiter, Pioneer 10 is again within the influence of the giant planet. The find also means Jupiter's tail stretches out 690 million km (430 million miles) from the planet.

The finding of a second magnetic tail created by a planet's magnetic field is another similarity between Jupiter and the Earth and adds to man's knowledge of planets. It also helps with understanding of basic plasma physics, the interaction between magnetic fields and ionized gases, which has various applications including energy production.

Some scientists had thought that since Jupiter spins so rapidly, its tail would be short because its field would be more tightly contained, or wound up around the planet, and not as stretched out as the Earth's.

"Jupiter, which has three quarters of all the planetary material in the solar system, is so huge that such a long tail is understandable," says Project Scientist Dr. John Wolfe. Jupiter and the Earth are the only two planets known to have strong magnetic fields created by the flow of liquid metal in their interiors. Magnetic tails are the magnetic envelopes around the planets stretched out by the force of the million-mile-per-hour solar wind, which "blows" constantly out from the Sun.

The Pioneers have measured the Earth's magnetic tail at 500 Earth diameters "down solar wind" from our planet, and considering the relative sizes of the two planets, the current measurements of Jupiter's magnetic tail are comparable to seeing the Earth's tail at a distance of 750 planet diameters downwind from Earth. The magnetic tails of both planets are beleived to be shaped like the tails of comets, and like comet tails, result from solar processes.

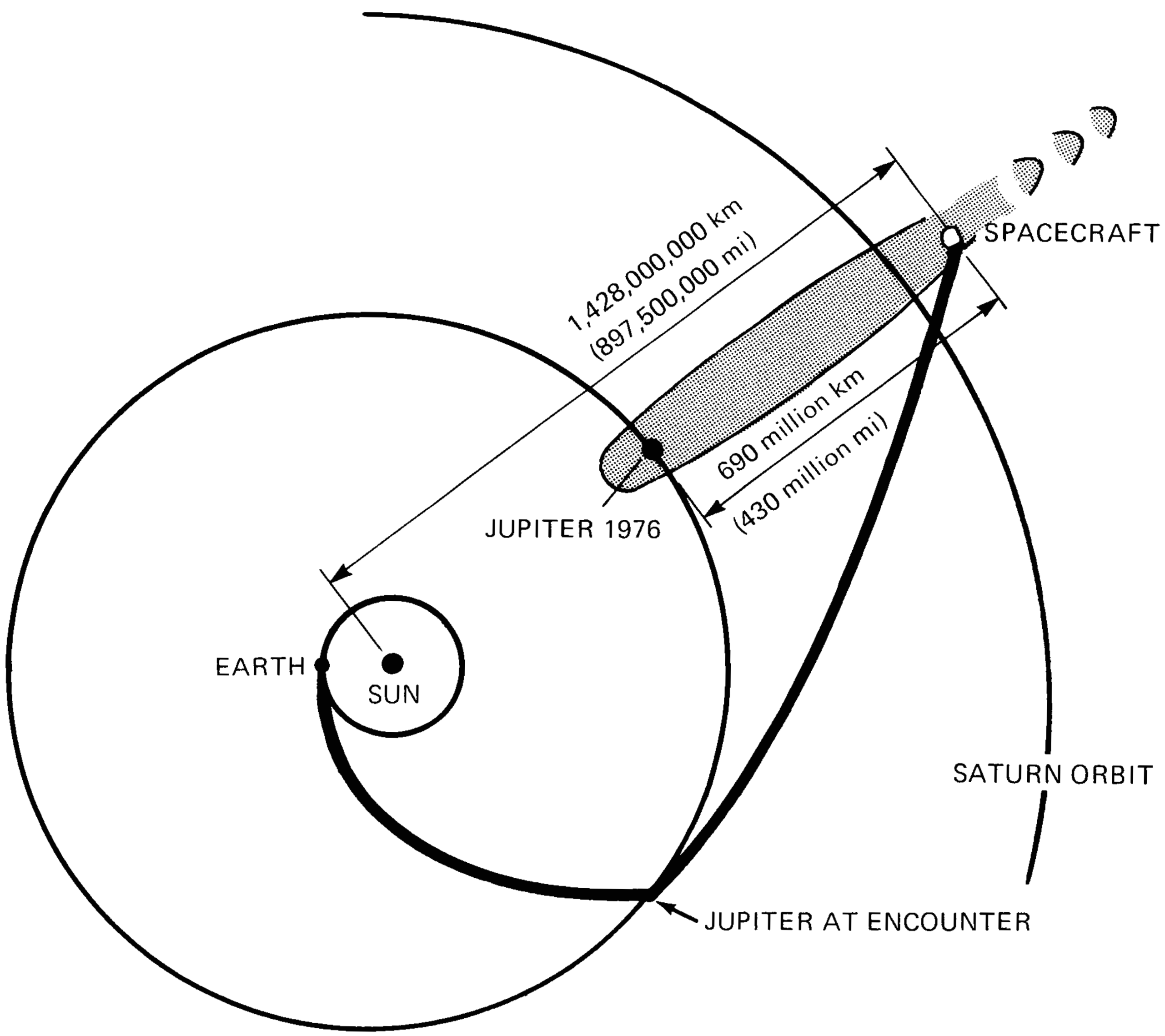
Pioneer 10 is actually 5000 Jupiter diameters (430 million miles) from Jupiter, almost directly outward from the Sun. However, compared to the Earth's, Jupiter's magnetic envelope or magnetosphere is huge, 14,280,000 km (8,876,000 miles) in diameter. On this scale, it is not surprising that the tail stretches this far out says Dr. Wolfe.

Also Pioneer 10 is six degrees, 100 million km (62 million miles) above the plane of Jupiter's orbit. Since the solar wind blows out radially from the Sun, the tail should be in Jupiter's orbit plane much of the time. However, the Pioneers have determined that the solar wind has strong turbulence even out as far as Saturn's orbit. This turbulent flow is easily enough to account for the tail being blown upward six degrees to intercept the spacecraft.

- end -

March 22, 1976

PIONEER 10 PASSES THROUGH TAIL OF JUPITER'S MAGNETOSPHERE



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Stan Miller 408/965-5091

For Release:
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Release No. 76-34

AVIATION SAFETY CONTRACT AWARD

A $939,000 contract has been awarded to the Battelle Memorial Institute of Columbus, Ohio, by NASA's Ames Research Center to aid in the administration of an "early warning" aviation safety system for the Federal Aviation Administration.

Under a two year contract, Battelle will assist NASA in implementing a new Aviation Safety Reporting System (ASRS) designed to obtain, from people in the national aviation system, reports on potential threats to flight safety. Reports on flight hazards will be processed, so that the originator of the report remains anonymous and so that the data can be used quickly by the FAA to avoid or reduce aircraft accidents.

NASA's role as the central point for collecting reports about United States aviation safety is designed to encourage voluntary participation by pilots, controllers, and other using the aviation system. The original ASRS was put into

- more -

May 13, 1976

action by the FAA in May, 1975, but because of the reluctance of people to report directly to a regulatory agency, NASA was invited to act as a "third party" in the new system to protect the anonymity of the volunteer reporter.

Dr. Charles E. Billings of Ames is the ASRS project manager for NASA and Dr. John Lauber is the project scientist. Larry Youngren at FAA Headquarters in Washington is the FAA Liaison Officer and Gene Lyman at NASA Headquarters is the NASA Liaison Officer.

EDITORS NOTE: Please see NASA Hq. Release 76-52 for further ASRS details.

- end -

May 13, 1976

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For Release:
IMMEDIATE

Release No. 76-79

GLOBE-SPANNING AIRBORNE EXPEDITION WILL CHECK UPPER ATMOSPHERE AEROSOL AND AIRCRAFT POLLUTION

Scientists aboard NASA's airborne research laboratory, the Galileo II, will fly nearly from pole-to-pole in a three-week north-south journey spanning the central Pacific. They will study two types of atmosphere pollution--that from aircraft engines and that from aerosol sprays, suspected of depleting the Earth's ozone layer. The expedition leaves Thursday, October 28.

The much-modified Galileo II Convair 990 flying laboratory, homebased at NASA's Ames Research Center, Moffett Field, CA will carry eight experiment teams, 18 scientists, from eight institutions. Part of them will be checking on changes in the upper atmosphere caused by exhaust gases from jet aircraft engines. A second group of scientists will measure the effects on the upper atmosphere of fluorocarbons and halocarbon gases from aerosol sprays and other sources.

- more -

October 27, 1976

The flights will last from Thursday, October 28 until Friday, November 19. Galileo II will fly first from Ames to Fairbanks, Alaska where flights will be made to the north of the Alaskan landmass over the Arctic Ocean, up to 75° north latitude. After Alaskan operations, Galileo II will fly on Saturday, October 30 south over the Pacific to Honolulu, and then on Wednesday, November 3 to Pago Pago, American Samoa. On Friday, November 5, the expedition will go to Melbourne, Australia; and on Wednesday, November 10 to Christchurch, in southern New Zealand. From there it will fly halfway to McMurdo Sound, Antarctica, down to 65° south latitude. Special flights will be made from Honolulu and from Melbourne.

The globe-spanning experiments from far-north to far-south are intended to collect data at many latitudes and in both northern and southern hemispheres to see if there are changes in upper atmosphere composition and pollutants with changes in latitude, and between hemispheres. Galileo II operates at between 35,000 and 40,000 feet. 12.1 km

10.6 km

Observations near the Hawaiian Islands will be coordinated with similar measurements made by NASA's high altitude Earth Resources Survey Aircraft (U-2), operating at around 60,000 feet. This aircraft, too, is based at Ames.

18.2 km

The survey of aircraft engine pollutants is a four-year cooperative effort between NASA-Ames and NASA's Lewis Research Center, Cleveland, aboard Galileo II. Experiment packages similar to those on Galileo are carried by wide-body jet transports of Pan American, United, and Qantas Airlines. The Galileo II flights are aimed at making measurements over a broad geographical range, in areas where commercial aircraft don't normally fly. Local flights into such remote areas will be made from Fairbanks, Honolulu, and Melbourne. Galileo II also will carry an advanced experiment package now in testing stages for this work.

Studies of aerosol spray pollution by experimenters are part of a broader program by NASA and other agencies to inventory the constituents of the upper atmosphere in a non-polluted state.

With this data in hand, changes from year to year in proportions of ozone, fluorocarbons, water vapor, carbon monoxide, and other compounds can be measured. Effects of these changes on the ozone layer and upper atmosphere mechanisms can be determined, as well as whether the changes are man-made.

The Galileo II measurements for both sets of experiments will be coordinated with similar measurements by National Oceanographic and Atmospheric Administration (NOAA) stations at Point Barrow, Alaska; Mauna Loa, Hawaii; and American Samoa; plus stations of the Australian Department of Science, the Commonwealth Scientific and Industrial Research Organization (CSIRO), and the Bureau of Meteorology in Australia and the New Zealand Meteorological Service.

Experimenters on the expedition are from: NASA Lewis Research Center; the Jet Propulsion Laboratory; NASA Ames Research Center; Office National d'Etudes et de Recherches Aerospatial, France; NASA Langley Research Center; Washington State University; and NOAA Atmospheric Physics and Chemistry Laboratory.

The current Galileo II expedition is expected to be followed by a similar far-north to far-south flight over the Atlantic Ocean. Some discussions have been held regarding a "pole-to-pole" type expedition crossing the European-Asian landmasses and far south into the southern oceans.

- end -

October 27, 1976

NASA News

National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, California 94035
AC 415 965-5091

Stan Miller 415/965-5091

For Release:
November 11, 1976

Release No. 76-80

NOTE TO EDITORS:
This is being released simultaneously by NOAA, Rockville, MD. Call William Brennan of NOAA for further information at 301/443-8243, or Louise Purrett of NOAA at Boulder, Co. at 303/499-1000, ext. 6286

AIR TURBULENCE WARNING NOW POSSIBLE

A scientist with the National Oceanic and Atmospheric Administration (NOAA) has found a technique that may give airplane pilots up to 12 minutes' warning of air turbulence ahead. The key to turbulence, according to Dr. Peter M. Kuhn of NOAA's Environmental Research Laboratories, is water vapor.

In tests aboard NASA's Galileo II, a flying laboratory, Kuhn has used an infrared radiometer -- which measures water vapor by the radiation it emits -- to predict turbulence with a reliability of 81 percent.

Clear air turbulence is thought to result from wave motions in the atmosphere, in shape much like those that break on the seashore. By experimenting with different

- more - October 28, 1976

infrared wavelengths, the Commerce Department scientist has been able to detect the breaking waves more than 60 miles (100 kilometers) ahead of the plane.

Kuhn discovered the connection between water vapor and turbulence while making water vapor measurements aboard the National Aeronautics and Space Administration Ames Research Center Convair 990 aircraft last year.

Water vapor in the atmosphere emits infrared radiation, and Kuhn was measuring that quantity to help NASA scientists determine how much of the radiation they were investigating was from astronomical objects and how much from the earth's atmosphere.

He noticed that sudden, drastic changes in the amount of water vapor were often followed within a few minutes by turbulence. To see if these fluctuations might be a reliable indicator of turbulence, the NOAA scientist compared his water vapor readings with those from an instrument that had been installed on the plane to make accurate measurements of turbulence, and found a relationship.

Since that time, Kuhn has continued his investigation, with the radiometer installed in the plane's main wheel well, looking ahead at an angle of between 7.5 and 15 degrees above the horizontal.

In 45 encounters with clear air turbulence, the radiometer provided advance warning of from four to 12 minutes in 41 cases, while giving only six false alarms. Kuhn thinks it ultimately may be possible to predict the severity of the turbulence.

Kuhn believes the water vapor anomalies the radiometer detects are caused by the wave motions of turbulence, which thin the water vapor in one place and concentrate it elsewhere. The concentration of water vapor at the altitudes where the research aircraft normally cruises--over 40,000 feet (12,000 meters)--is fairly constant. The turbulent wave motions shatter this placid picture, producing alternating dry and wet areas.

The atmospheric waves that cause turbulence, Kuhn explains, can be set up in two ways. Winds flowing over a mountain range may set up a standing wave above or in the lee of the mountains. Such lee waves cause frequent turbulence above the Rockies and occasional severe wind storms along the eastern slope of the range.

The other atmospheric condition creating such waves is strong vertical wind shear--a sudden shift in wind speed or direction with height. The friction between two adjacent streams of air causes turbulence.

- end - October 28, 1976

NASA News

National Aeronautics and
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~~Peter Waller~~ 415/965-5091

For Release:
IMMEDIATE

Release No. 76-84

VENUS PROBE TO BE TESTED IN BALLOON DROP

The plunge into the atmosphere of Venus of the main probe for NASA's 1978 Pioneer Venus mission will be simulated next week by drop of the probe from an Air Force balloon, 32 kilometers (20 miles) above the Army's White Sands Missile Range in New Mexico.

The main probe is designed to carry instruments for the detailed measurement of Venus' atmosphere.

The test, sometime between December 13 and 16, will duplicate flight events just before descent into the planet's dense, hot lower atmosphere.

The test will occur at an Earth altitude of 16 km (10 mi.) where atmosphere temperature and density and probe velocity are much the same as those on Venus.

- more -

December 3, 1976

To be demonstrated are: deployment of the probe parachute; separation of its atmosphere entry heat shield; and, after 17 minutes of parachute descent, separation of the parachute for flight of the probe instrument vessel down to Venus' searing surface.

Objective of the two-spacecraft Pioneer Venus mission is to characterize Venus' relatively simple atmosphere and weather. Scientists believe this knowledge will help them understand Earth's complex weather patterns.

Two coordinated Pioneer Venus spacecraft will be launched to the cloud-shrouded planet in 1978, one in May and one in August. Both will arrive in December 1978. The orbiter spacecraft will circle Venus for a year or more. The Multiprobe spacecraft carries the main probe and three smaller probes. The four probes will enter the atmosphere on arrival, some 8,000 km (5,000 mi.) apart, and reach the surface in an hour. The main probe and one small probe will enter on the planet's day side, two other small probes on the night side. All four will measure the atmosphere from top to bottom.

The Pioneer Venus project is managed by NASA's Ames Research Center, Mountain View, Calif. Next week's test of the large probe will be carried out by the U.S. Air Force Geophysics Laboratory (AFGL) using a 90,000-cubic-meter (3-million-cubic-foot) high-altitude plastic balloon.

The balloon will be launched from the Municipal Airport at Truth or Consequences, N.M., with prevailing westerly winds carrying it over the White Sands Missile Range. At White Sands, Army personnel will track the entering probe and later recover all parts of the probe system.

For entry into the planet's atmosphere, the Pioneer main probe will separate from the Multiprobe spacecraft 12 million km (7.5 million mi.) out from Venus and enter the atmosphere at 40,950 kph (26,000 mph). Atmospheric drag will slow the probe to 720 kph (450 mph) at 67 km (42 mi.) above the surface. At that point, the heat shield is jettisoned, and the parachute opens, slowing the probe in 17 minutes to 36 kph (22 mph). The parachute then separates.

With no chute, the probe instrument vessel will cover the remaining 47 km (29 mi.) to the surface in 40 minutes, first speeding up to 216 kph (134 mph), and then slowing due to rapidly increasing atmosphere density until impact at 43 kph (27 mph).

(Pressure at Venus' surface is 100 times Earth's.) The fast final descent is needed to reach the searing surface before atmosphere heat destroys the instruments. Temperature at the surface is more than 500 degrees C. (920 degrees F.). This is hotter than the melting point of zinc.

The test will take place far lower on Earth than the actual entry on Venus. At the test altitude of 15 km (10 mi.) above Earth, the atmosphere temperature, density and probe velocity will be very nearly the same as that expected on Venus at 67 km (42 mi.) above the surface, the point of actual parachute deployment.

Next week's demonstration will be the first of two probe drop tests. The second is scheduled for early 1977. After launch from Truth or Consequences, the huge balloon will rise in an easterly direction, reaching 30,000 meters (100,000 feet) over White Sands in about two hours.

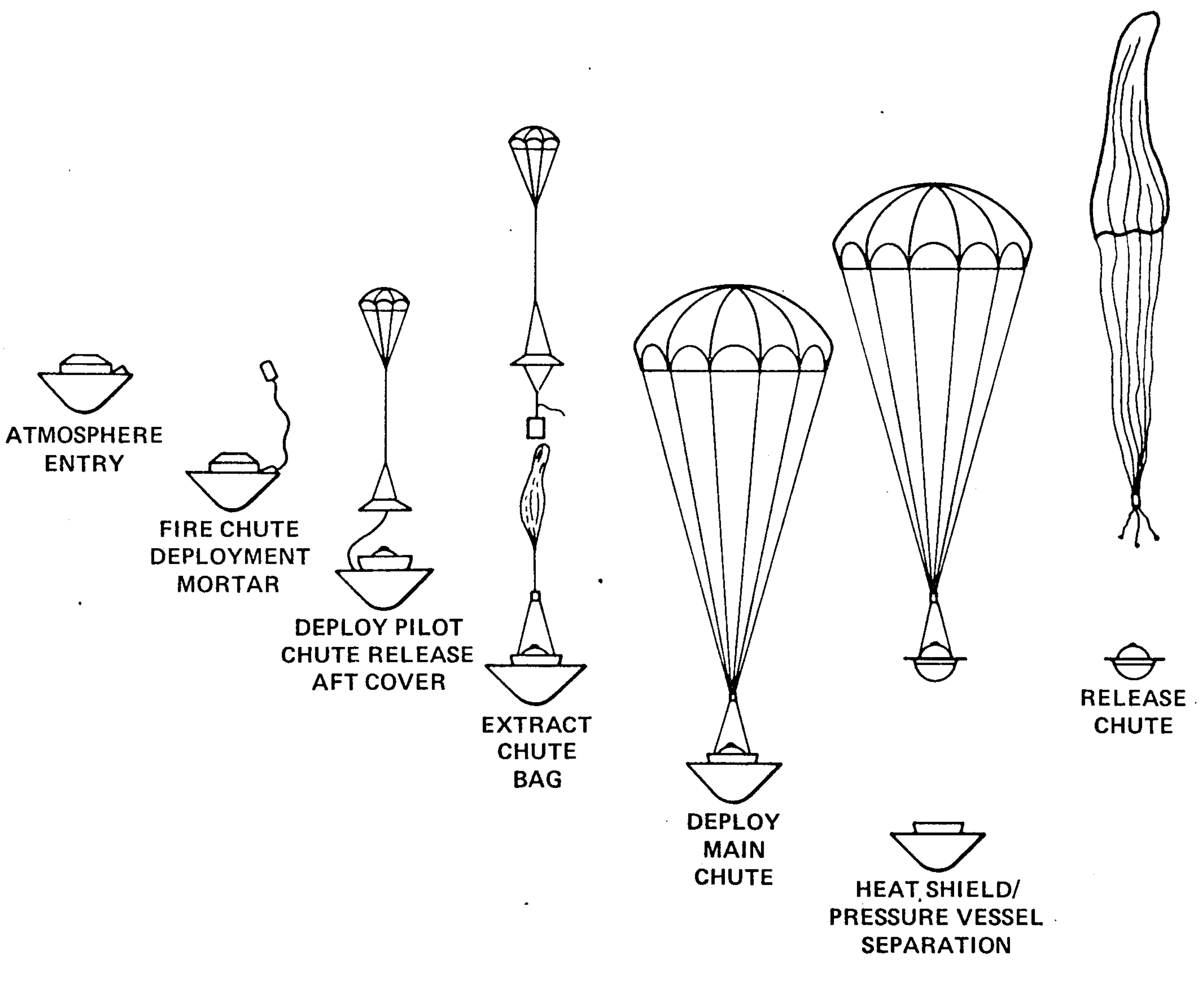
The instrumented vessel will contain special equipment to record system performance. Movie cameras on the balloon platform, others looking back from the instrument vessel, as well as telescopic still and movie cameras on the ground, and range radar will record the test.

NASA's Ames Probe Systems Manager is Simon C. Sommer. Captain Robert Greenlee, AFGL, is project officer for the balloon system. AFGL has long experience with high altitude balloon tests, most recently with the Viking lander for Mars.

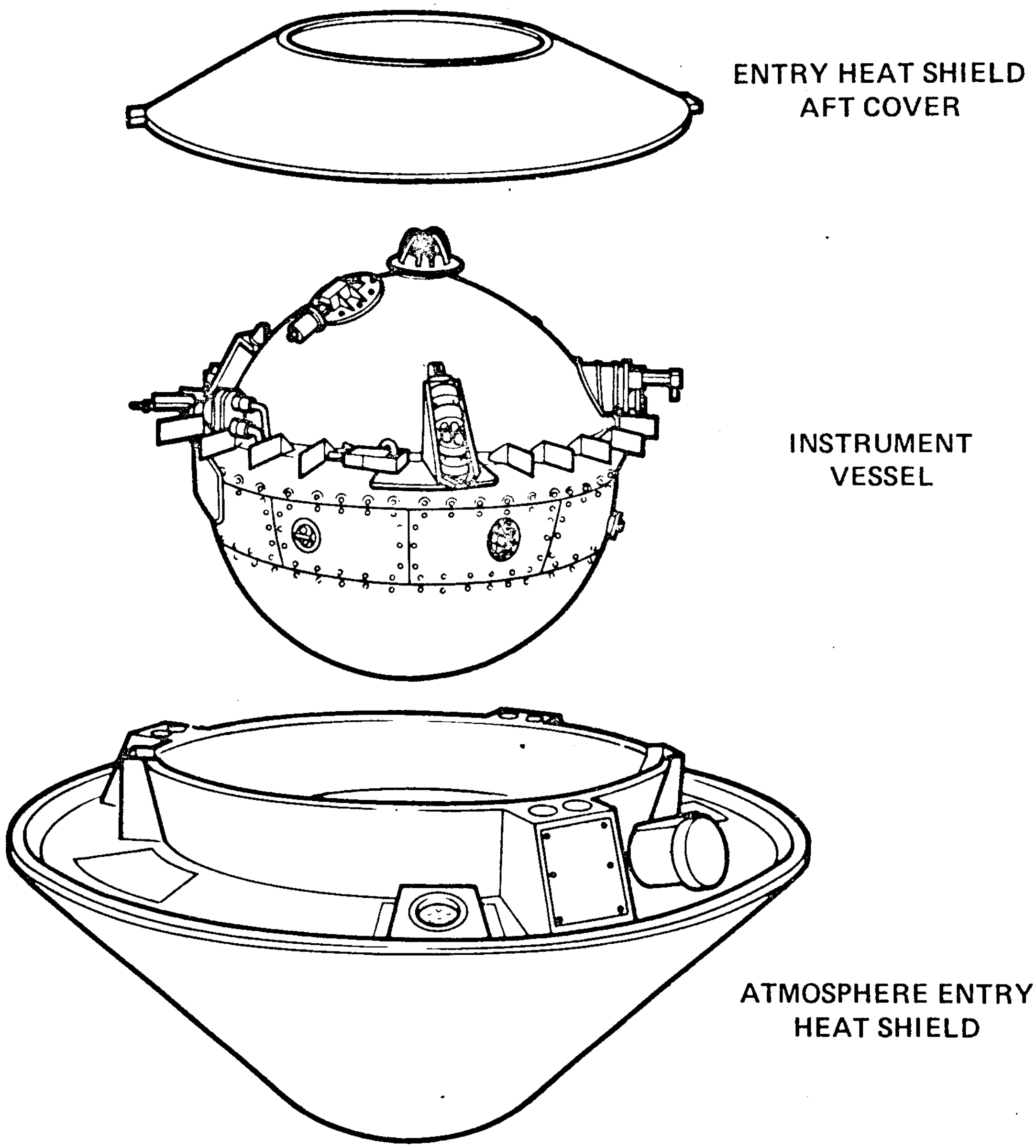
The Pioneer spacecraft are built by Hughes Aircraft Co., Culver City, Calif., prime contractor. General Electric Co., Philadelphia, makes the probe entry system.

- end - December 3, 1976

PIONEER-VENUS
BALLOON DROP AND SEPARATION SEQUENCE



PIONEER-VENUS MAIN PROBE



NASA News

National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, California 94035
AC 415 965-5091

Peter Waller 415/965-5091

For Release:
MONDAY
12:00 Noon

Release No. 76-85

STRUCTURE OF SUN'S MAGNETIC FIELD FOUND

The structure of the Sun's magnetic field has been confirmed for the first time by flight of the Pioneer 11 spacecraft into unexplored space, high above the plane of the Earth's orbit.

The major discovery accords very well with theoretical ideas of the Sun's field advanced by several scientists.

Pioneer 11 is managed by NASA's Ames Research Center, Mountain View, CA, near San Francisco, and is now making the first trip to Saturn.

The discovery was announced today by Dr. Edward J. Smith, Jet Propulsion Laboratory, Pioneer 11 magnetometer experimenter. Theoretical work on the problem was pioneered by Dr. Hannes Alfven, University of California, San Diego, Nobel Laureate, and Dr. Michael Schulz, Aerospace Corporation. The model was further developed by Drs. Leif Svalgaard and John M. Wilcox, Stanford University.

- more -

December 6, 1976

The solar-system-spanning, roughly-spherical magnetic field of the Sun now appears to have a simple north pole-south pole structure. The field is split into northern and southern hemispheres at its magnetic equator by a warped electric current sheet (see drawing).

The finding seems to show that in some ways the Sun's field is like the fields of those planets which have strong magnetic fields (the Earth and Jupiter). Both have current sheets something like the Sun's.

The discovery is important because the Sun is the Earth's source of light and energy, and solar mechanisms are, therefore, critical. It is also important because solar magnetic storms channeled by the solar field are believed to affect the weather, and because the finding almost certainly applies equally well to the billions of Sun-like stars in the universe.

"In recent years, there have been a variety of models of the solar field, and this finding clears away a lot of underbrush," says Dr. John Wolfe, Ames Research Center, Pioneer Project Scientist.

Dr. Smith announced his findings at the American Geophysical Union meeting, San Francisco.

The Sun's magnetic field is believed to extend several billion miles above the Sun's north and south poles. It is known to reach well beyond Saturn's orbit, and probably extends as far as the orbit of Pluto, almost four billion miles. The field, generated by electric currents in the Sun, is stretched far outward in every direction by the million-mile-an-hour "solar wind" of charged particles, which flows constantly out from the Sun.

On its way across the solar system to Saturn, Pioneer 11 has been thrown 100 million miles above the Earth's orbit plane, as a result of its passage close to Jupiter in December 1974. This allowed the spacecraft to measure solar phenomena at a point 16^{o} above the Sun's equator (9^{o} higher than ever before). There it found a uniform solar field pointing away from the Sun.

Workings of the Sun and its magnetic field have long appeared bizarre, and have been a subject of much speculation. The Sun's field reverses its direction every 11 years near the maximum development of the sunspot cycle. During this reversal process, solar magnetographic measurements have suggested that the general field is weak and disordered. Since the Sun's equatorial regions rotate faster than the polar regions, the surface fields near the equator appear to get wound round and round the Sun's middle like taffy, and magnetic fields there often run east-west.

For the field as a whole, the field lines come out of most of the northern hemisphere and are carried out by the solar wind. In most of the southern hemisphere the field direction is reversed and comes back in toward the Sun.

Near the magnetic equator northern and southern fields are separated by a warped sheet of electric current. These electric currents tend to circle the Sun in the inner solar system, but gradually turn and finally flow outward in the outer part of the solar system. Field direction reverses every 11 years.

As the Sun rotates the warped equatorial current sheet appears to move up and down relative to the Earth's orbital plane. Since all spacecraft before Pioneer 11 have traveled in the Earth's orbital plane, the current sheet passes through them each time it is warped down below the spacecraft, and repasses them when warped upward again. This means these spacecraft are in a magnetic field direction away from the Sun when above the current sheet and in the magnetic field direction toward the Sun when below it.

This, in turn, means that these earlier spacecraft have seen reversals in magnetic field direction each time the current sheet passed through them, and this has led to a variety of interpretations.

"Theory appears to confirm the two-hemisphere model of the Sun's field," comments Dr. Hannes Alfven, who has been associated with Dr. Smith in parts of the work.

In the warped current sheet model, as described by Drs. Svalgaard and Wilcox, the current sheet in interplanetary space has a range in latitude that near sunspot minimum, as at present, is about 15^{o} on each side of the Sun's equator. When Pioneer 11 was 16^{o} away from the solar equator it was "too far north" (too high above the warped current sheet) for the sheet to pass through it, and hence the field reversals disappeared.

The random, small-scale magnetic fields in the Sun's midregion have closed field lines which extend only a little into the corona but not beyond. These intense fields, says Dr. Smith, are "often all mixed up" due to the Sun's violent convection and uneven rotation. The north polar region, on the other hand, has a well-ordered field in just one direction, and the south in the opposite direction. This large-scale magnetic configuration greatly eases the outflow of the solar wind and depletes the solar corona of charged particles. This leads to formation of "coronal holes," which nearly always occupy the polar regions, and often extend down below the solar equator. The outflowing solar wind carries the solar magnetic field out until the solar wind ends at the boundary with the interstellar gas, perhaps near Pluto's orbit. There the outgoing north solar field may link up with the incoming south solar field to "close the magnetic loop." "Perhaps the north and south field components never do link up", says Dr. Smith. "They could instead join with the interstellar magnetic field at the boundary. However, the effect is the same with either alternative: you have a relatively simple field, something like the Earth's, but stretched far outward from the Sun by the solar wind."

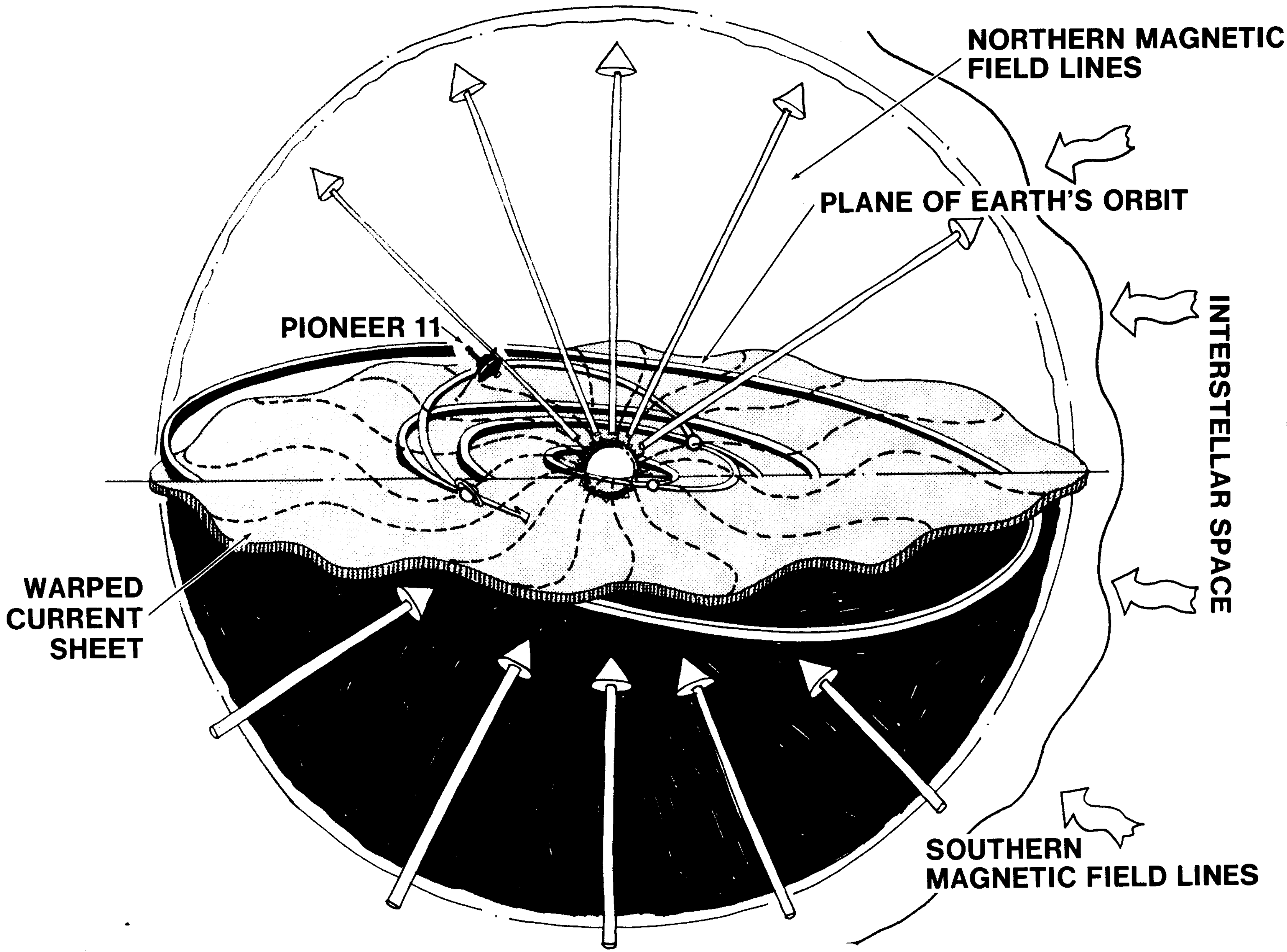
The Pioneer 11 observations were made from February to November of 1976, when the spacecraft was four times farther from the Sun than the Earth.

The warped current sheet model as confirmed by the Pioneer 11 measurements will have important implications for the motion of cosmic rays in the solar system. In recent work by Dr. Eugene Levy, University of Arizona, the two opposed magnetic fields divided by a current sheet should channel cosmic rays parallel to the sheet. This effect has been observed and now seems explained. A change in the extent in latitude of the warped current sheet may explain the sunspot cycle variation in cosmic ray intensity observed at Earth.

- end -

December 6, 1976

MAGNETIC FIELD OF THE SUN



National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, California
94035

NASA

Reply to Attn of:

NOTE TO EDITORS:

The attached release describes a new phase of medical research at Ames to establish criteria for selection of Space Shuttle passengers in the 1980s.

Ground rules set by Ames to assure research integrity of the tests do not permit visits by newspeople to the facility where the tests are conducted or interviews with test subjects during the course of the experiments.

To assist newspeople in getting additional details and photography of the facilities, and to introduce the test volunteers, we plan to have an advance press briefing at 1:00 p.m., Tuesday, April 12, in the Ames Auditorium, Bldg. 201. The Principal Investigator, Dr. Harold Sandler and key members of the project staff will discuss the medical protocol, and there will be an opportunity to visit the bedrest facility. At the conclusion of the study, we will set up a "results" press briefing.

Please call me if you need more information.

Stanley A. Miller
Public Affairs Officer
415/965-5091

age group and sex how weightlessness might affect the body in general and its ability to react to reentry. Two of the ten women, during the nine day bedrest, will also take some commonly used medicines to see how weightlessness and reentry might affect the body's disposition of these compounds.

Bedrest studies at Ames have included groups of younger men and women and the most recent was with a group of men, age 35 to 45, completed last year. The series is intended to find out, from a medical point of view, how age, sex and physical condition might affect selection of Space Shuttle passengers.

- end -

March 10, 1977

NASA News

National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, California 94035
AC 415 965-5091

Stan Miller 415/965-5091
Public Affairs Officer

For Release:

NOTE TO EDITORS:

The NASA Kuiper Airborne Observatory expedition which discovered rings around the planet Uranus will return to Ames Research Center from Australia and Pago Pago at 10:00 a.m., Wednesday, March 30th. Newspeople are invited to view the C-141 aircraft arrival and attend news briefings about the Uranus discovery and preliminary results of infrared experiments now in progress. These IR experiments are yielding important new information about the Magellanic Clouds of the southern hemisphere.

Dr. James Elliott of Cornell University will present his findings about Uranus at approximately 10:30 a.m. After a tour of the aircraft and lunch in the Ames cafeteria, representatives of the Infrared Experiment teams will discuss their findings at 1:00 p.m. The briefings will be held in the auditorium of Bldg. 245. Those attending the return of the expedition should proceed from the NASA Gate to the NASA Hangar, Bldg. 211, at about 9:45 a.m. Those attending only the briefings should proceed directly to the Bldg. 245 auditorium before 10:30 a.m.

Please call the Ames Public Affairs Office, 415/965-5091, further information.

NASA News

National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, California 94035
AC 415 965-5091

Peter Waller 415/965-5091

Release No. 77-17

For Release:
10:30 a.m. PST
Wednesday,
March 30, 1977

NOTE:
This story is being released
simultaneously by NASA-Ames,
NASA Headquarters, and
Cornell University

PLANET URANUS' RINGS DISCOVERED

Rings orbiting the planet Uranus--the first major structures in the solar system to be found since the discovery of the planet Pluto in 1930--have been identified by Cornell University researchers flying aboard the NASA-Ames Research Center Kuiper Airborne Observatory.

Uranus is the seventh planet out from the Sun, one of the giants of the outer solar system. It is almost 1.6 billion kilometers (a billion miles) beyond Saturn, until now the only ringed planet, and is unique in "lying on its side" with its rotation axis almost in its orbit plane.

Dr. James Elliot, senior research associate at Cornell's Center for Radiophysics and Space Research, assisted by graduate student Edward Dunham and computer programmer

March 25, 1977

Douglas Mink, made the discovery on March 10 while they were observing the temporary disappearance (occultation) of a faint star behind Uranus. The expedition was carried out by the Ames Center's Kuiper Observatory project team, headed by Carl Gillespie, expedition manager. The observations were made at 12,300 meters (41,000 feet) altitude, 2,000 km (1200 miles) southwest of Australia over the southern Indian Ocean.

Elliot and his associates have inferred the presence of five rings orbiting Uranus, all of them in a narrow belt 7,000 km (4400 miles) wide, lying 18,000 km (11,000 miles) out from the cloud tops of the planet. The five rings appear to consist of four thin inner rings, perhaps 10 km (6 miles) across, that follow nearly circular orbits around the planet, and one thick outer ring, about 100 km (60 miles) wide, whose orbit may not be exactly circular.

Observations of the Uranus occultation made independently at Perth, Australia by Robert Millis of Lowell Observatory, and by astronomers at Capetown, South Africa agree with the interpretation of at least five rings surrounding Uranus.

The rings are considerably smaller than those encircling Saturn. Elliot's data indicate that they are probably made up of fragments smaller than two kilometers (one mile) in diameter. They have never before been observed, because the light reflected from the planet is sufficiently bright to obscure the lesser reflections from the rings under normal viewing conditions, Elliot said.

Elliot has named the rings for the first five letters of the Greek alphabet--alpha, beta, gamma, delta and epsilon.

Ames' Kuiper Observatory, from which the observations were made, is a highly-modified C-141 aircraft, and is a national facility available to astronomers. Named for pioneer planetary astronomer Gerard P. Kuiper, who discovered Uranus' fifth moon, it carries the world's largest airborne telescope, and has made various discoveries. For the Uranus flight, because of its mobility, the C-141 provided the best solution, flying far out over the southern oceans. It flew far enough south to be well within the shadow of Uranus, and far enough into the Earth's night hemisphere to see occultations of the rings on both sides of the planet, as well as to be above any clouds. This combination of factors was not possible from any single ground-based observatory, and, in fact, several ground observatories were clouded out.

Viewing of the second ringed planet was done through the Observatory's 91 cm (36 inch) telescope, stabilized by gyroscopes and a tracking system that compensates for changes in altitude of the plane during flight. The C-141 flew above 75 percent of the Earth's atmosphere. Data were displayed for the Cornell observers on a television screen, and variations in intensity of the light were recorded on magnetic tape and plotted automatically on graph paper.

Elliot and his associates observed the occultation of the star SAO 158687 by Uranus to learn the planet's precise diameter and to study the composition and temperature of its atmosphere by recording changes in the light intensity from the star as it passed near and then behind the planet. The discovery of the planet's rings was an unexpected benefit.

Approximately 40 minutes before the star was scheduled to pass behind Uranus, Elliot and his associates noticed a sudden blackout of the light from the star lasting approximately seven seconds. During the next nine minutes, the light from the star was blocked out four more times.

No changes in light coming from the star were recorded during the next 30 minutes. The star then moved behind the main body of the planet, which blocked out its light for about 25 minutes.

Observations made as the star moved beyond Uranus confirmed that Elliot and his colleagues had indeed observed rings around the planet--the light from the star was blocked out another five times at intervals corresponding to the first blackouts.

Had the original blackouts been caused by moons or other small objects, it is unlikely that they would have occurred with such regularity as the star emerged from behind the planet, Elliott explained.

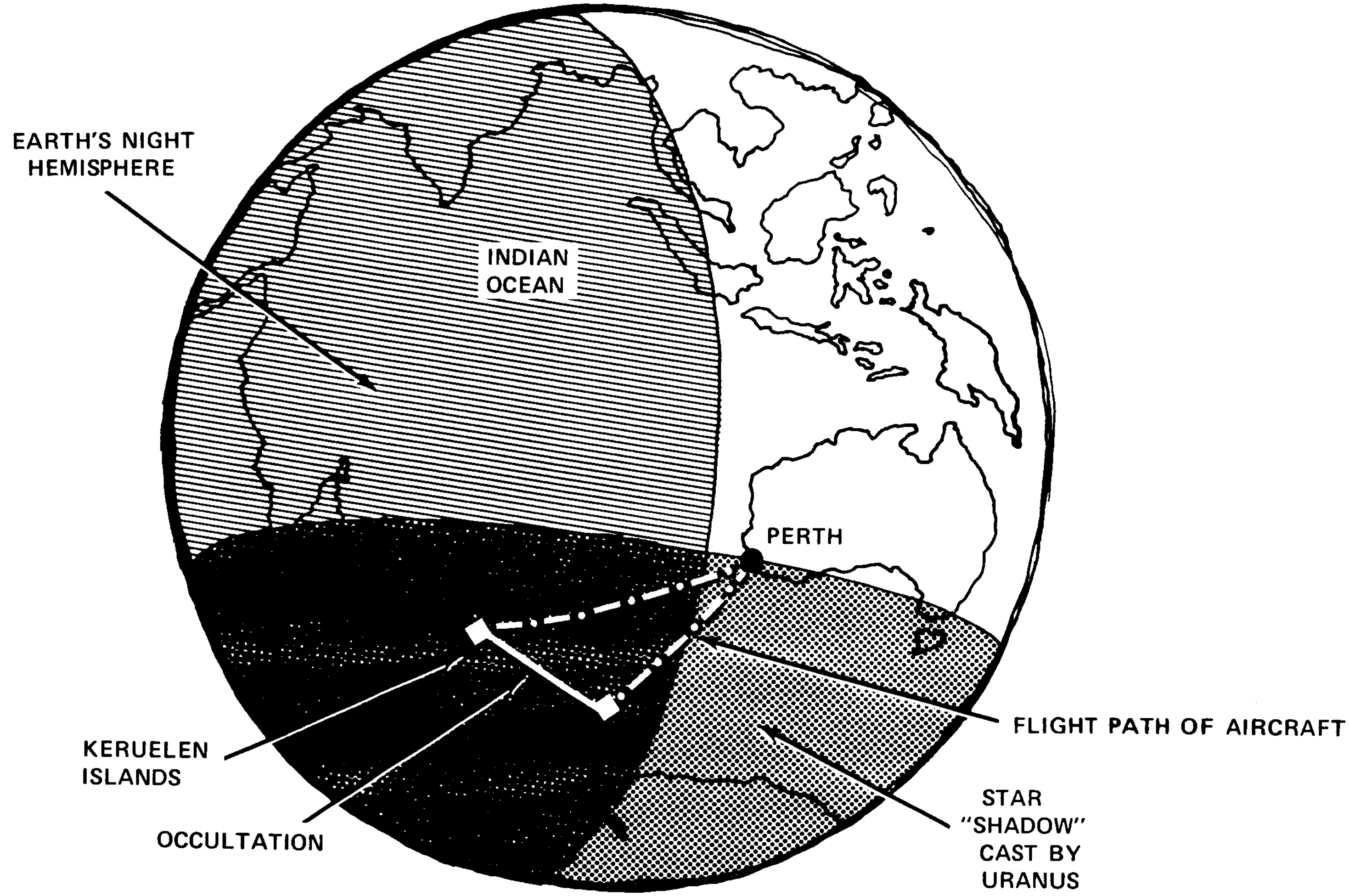
March 25, 1977

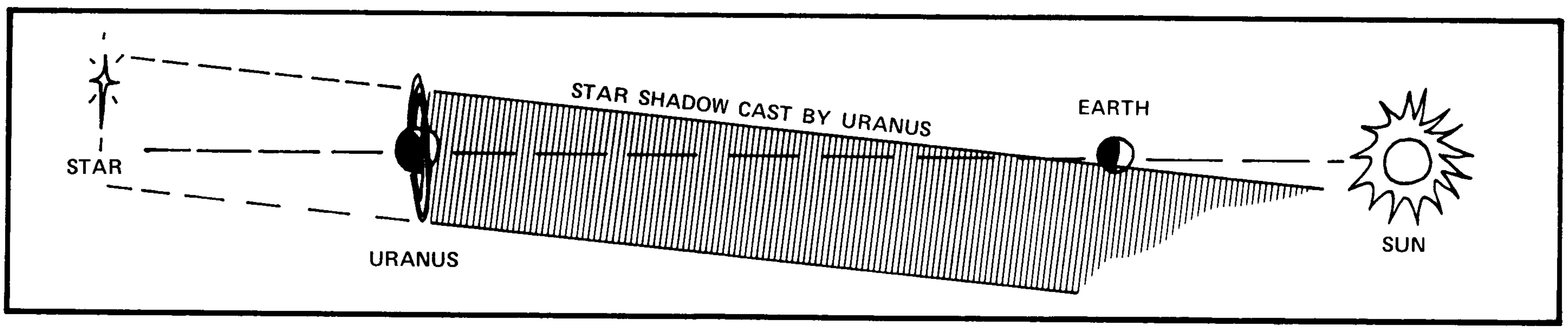
Elliott suspects that the rings are composed of material present during the formation of the solar system that never coalesced into moons or that they are the remnants of a moon (or moons) which disintegrated at a later time in Uranus' history.

He and his associates currently are analyzing their data further--looking for dust between the rings and other clues that might substantiate either theory of ring formation--and will soon begin working with theoretical astronomers to put the pieces of the solar system puzzle together.

- end -

March 25, 1977


EARTH'S NIGHT HEMISPHERE
INDIAN OCEAN
PERTH
FLIGHT PATH OF AIRCRAFT
KERUELEN ISLANDS
OCCULTATION
STAR "SHADOW" CAST BY URANUS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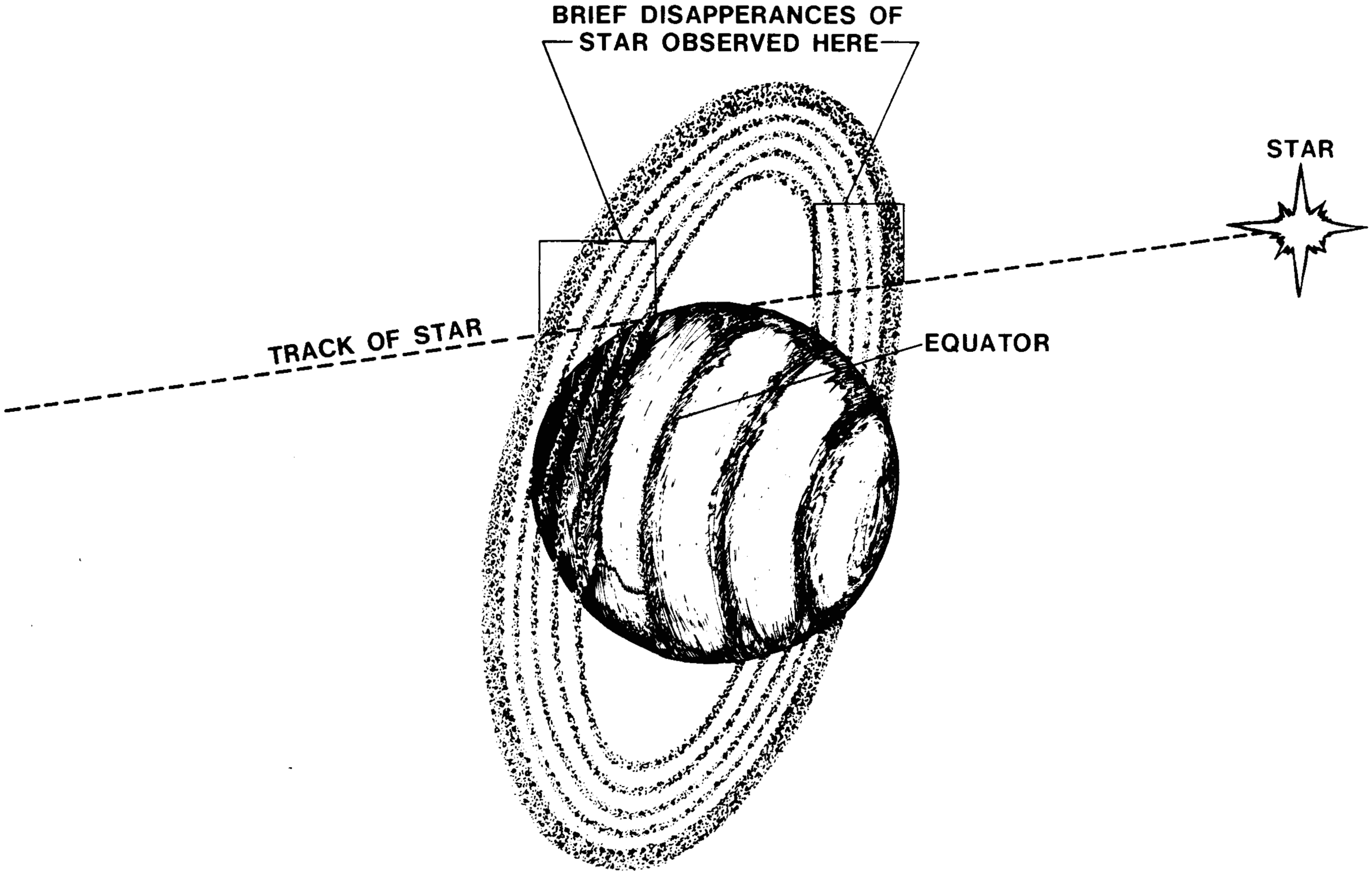
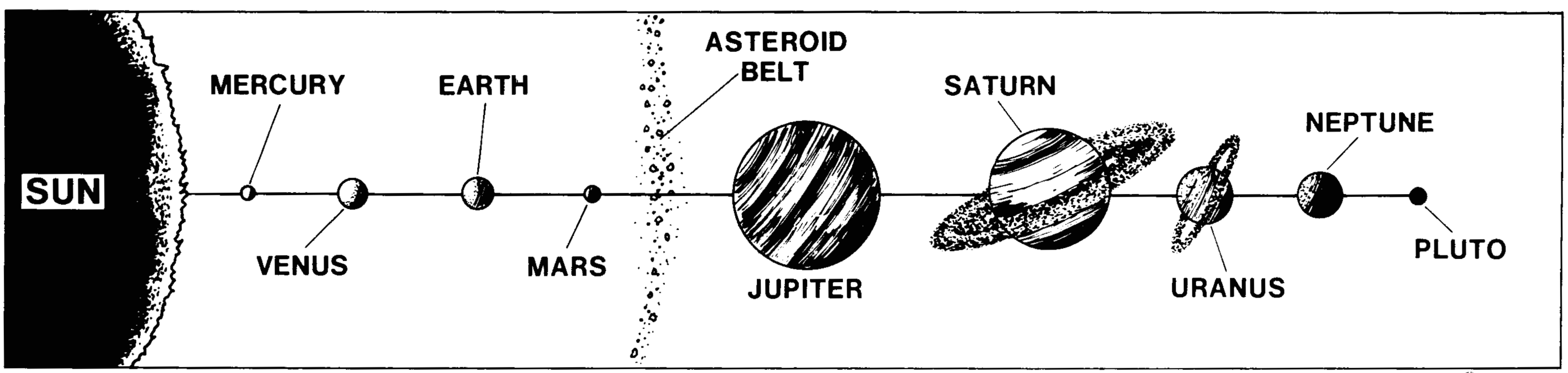
PLANET URANUS' RINGS





NASA News

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Stan Miller 415/965-5091

For Release:
IMMEDIATE

Release No. 77-19

NASA'S AMES RESEARCH CENTER ASSUMES LEAD ROLE IN HELICOPTER RESEARCH

The National Aeronautics and Space Administration (NASA) today began implementation of its plan to establish Ames Research Center, Moffett Field, CA, as lead Center for helicopter research.

Approved last summer, the plan resulted from a NASA assessment of its overall research activities to identify areas where realignment would increase the effectiveness in research output and reduce costs. This is of particular importance in view of growing competition from foreign industry in the helicopter field.

Consistent with its roles and missions responsibility for short-haul air transportation, Ames was designated the leading NASA Center for helicopter research. Both NASA's Langley Research Center, Hampton, VA, and Lewis Research Center, Cleveland, OH, however, will have responsibilities for key segments of the helicopter activities.

March 31, 1977

Ames will conduct helicopter research on small-scale and large-scale hardware using aeronautical facilities including its 40-by-80 foot wind tunnel and flight simulation capabilities and will conduct flight tests with research rotorcraft such as the Tilt Rotor Research Aircraft and Rotor Systems Research Aircraft.

Langley will emphasize helicopter structures and continue some disciplinary research in acoustics, airfoils, aeroelasticity, and avionics components.

Lewis will emphasize helicopter propulsion with the first step being a proposed new program in helicopter transmission technology. This program will include helicopter engine technology in a later phase.

A NASA Headquarters Helicopter Program Office will be responsible for formulation of the overall agency helicopter program and integration of the research efforts of Ames, Langley, and Lewis.

Over the next three years these changes will result in 72 positions being added to the Ames staff. During the period of transfer, the Langley activity in helicopters will be phased down but will continue at a level of 72 man-years engaged in continuing helicopter work.

With the expected growth in Langley Long-Haul Aircraft Technology activities, it is anticipated that there will be little long term impact on Langley manpower and the local economy[redacted].

March 31, 1977

NASA News

National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, California 94035
AC 415 965-5091

Peter Waller (415/965-5091)

For Release:

(being released simultaneously
by NASA Headquarters)

Immediate
14 April 1977

Release No: 77-20

NASA AWARDS STUDY CONTRACTS FOR JUPITER PROBE

NASA has awarded two $350,000 contracts to two industry teams for the development of specifications for a space vehicle to plunge deeply into Jupiter's atmosphere.

McDonnell Douglas Corp., St. Louis, Mo., and the team of Hughes Aircraft Co., El Segundo, Calif., and General Electric Co., Philadelphia, have received parallel contracts for design studies of an entry vehicle which would reach the giant planet in late November 1984, and make detailed measurements of its atmosphere and clouds.

The atmospheric entry vehicle would be the probe component of NASA's planned Jupiter Orbiter with Probe mission, requested as a new start in the space agency's budget for fiscal 1978.

The design studies will continue for 10 months, with a second-phase competition for hardware development planned for the spring of 1978 if Congress approves the project.

(more)

NASA Awards Study Contracts for Jupiter Probe

The JOP mission offers the first opportunity to make in situ as well as remote measurements of the planet, its environment and its satellites, from various orbiting positions.

The basic mission as now envisioned will involve probe separation from the orbiter while the two spacecraft are approximately 55 days away from the planet. The two spacecraft will continue on separate flight paths until the probe enters the Jovian atmosphere and relays its data back to Earth via the orbiter. Approximately 30 minutes of data will be transmitted to the orbiter during the high speed descent.

After termination of the entry probe phase, the orbiter will be inserted into its initial Jovian orbit by an onboard retro propulsion system. Subsequent propulsion adjustments will permit the spacecraft to fly close to the Jovian moon Ganymede and to make more distant encounters with the other large Galilean satellites of Jupiter.

A single launch by NASA's Space Shuttle is planned for late 1981 or early 1982, and flight time to Jupiter will be just under three years.

The orbiter will be operated in orbit around Jupiter and near its moons for at least a year.

NASA's Office of Space Science has assigned management of the JOP project to NASA's Jet Propulsion Laboratory,

(more)

NASA Awards Study Contracts for Jupiter Probe

Pasadena, Calif. NASA's Ames Research Center, Mountain View, Calif., will manage the probe system. The NASA Space Transportation System (Space Shuttle and Interim Upper Stages) will be managed by the Johnson Space Center, Houston, Texas.

Total project cost is estimated at $285 million.

- end -

April 14, 1977

NASA News

National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, California 94035
AC 415 965-5091

Larry King 415/965-5091

For Release:
IMMEDIATE

Release No. 77-21

NASA AMES CENTER PLANS AIRCRAFT SIMULATION OF SHUTTLE MISSIONS

NASA and the European Space Agency (ESA) are preparing for a 10-day simulation of a 1980s Spacelab mission, using an aircraft packed with Spacelab-type hardware and experiments and a mobile van to provide living quarters to permit isolating the crew as they would be on a space mission.

The mission, called ASSESS II (Airborne Science/Spacelab Experiment System Simulation), will begin May 16 and will involve a mission specialist and four payload specialists (two from ESA and two from NASA) who will be constrained to the aircraft and van for the 10-day period.

ASSESS II will test techniques and modes of operation which will be applied to Spacelab, a space laboratory being developed by ESA in a cooperative program with NASA.

- more - 4/20/77

Spacelab is a major element of the Space Shuttle System being developed to transport people and equipment on a routine basis between ground and Earth orbit. Spacelab will have facilities and equipment similar to laboratories on the ground, providing a shirtsleeve environment for a small group of experimenters.

Throughout each mission, Spacelab will remain in the cargo bay of the Shuttle Orbiter where the research personnel will eat and sleep. Since there will be more experiments than research personnel on Spacelab flights it will be necessary for each person to operate more than one experiment.

Objectives of the simulation, in addition to obtaining basic scientific information, include evaluation of management of payload and mission operations to develop low cost concepts for Spacelab, studies of interactions between experiment operators (payload specialists) in Spacelab and principal investigators on the ground and development of minimum training requirements for Spacelab participants in carrying out experiment operations.

A further objective is to evaluate a plan to include use of principal investigators as payload specialists.

The ASSESS II mission will be flown on Galileo II, a Convair 990 four-jet transport aircraft which has been converted to a sophisticated flying laboratory and is used by NASA for a variety of scientific missions. The aircraft will make six-hour flights on each of the 10 days of the simulation and the payload and mission specialists will remain confined throughout the 10-day period to work on the experiment payload and sleep in adjacent living quarters.

Six simulated Spacelab missions have been conducted since the program began in 1972 -- each mission designed to evaluate potential Shuttle-Spacelab concepts in increaseing detail. ASSESS II is the second mission to use the Galileo flying laboratory. The first, ASSESS I, was conducted jointly with ESA in June 1975 and involved five data flights over a six-day confinement period.

ASSESS II is a joint effort by NASA and ESA. Of the 10 instrument packages, five are furnished by ESA and five are furnished by NASA. The experiments are generally in the fields of Earth resources, atmospheric pollution monitoring and infrared astronomy.

A prime objective of the ASSESS II operation is to involve the actual ESA and NASA Spacelab management elements in the same roles they will have during an actual Spacelab flight. On the NASA side, these elements include NASA Headquarters in Washington, D. C.; Marshall Space Flight Center, Huntsville, Ala., which is managing the mission; Johnson Space Center, Houston, Tex., in charge of flight operations; and Kennedy Space Center, Fla., to handle integration similar to the plans for Spacelab integration at Cape Canaveral.

 April 20, 1977

The ASSESS II simulation will take place at the Ames Research Center, Mountain View, Calif., which operates the NASA Galileo aircraft. Operations will include a Mission Control Center and a Payload Operations Control Center under the management of Johnson Center and Marshall Center respectively.

Astronaut Karl Henize of Johnson Center will serve as mission specialist for the simulation. His duties include controlling and monitoring aircraft (spacecraft) experiment support systems, coordinating activities of the payload specialists and providing interface between payload specialists and the Galileo flight crew.

Another astronaut, Robert Parker, who was a member of the ASSESS I simulation team, will serve as backup mission specialist.

NASA and ESA will each provide two payload specialists for the mission. NASA has designated Robert T. Menzies and David S. Billiu, both of NASA's Jet Propulsion Laboratory, Pasadena, Calif., as prime payload specialists. Menzies is also a principal investigator for one of the experiment packages. Leon B. Weaver, Marshall Center is backup to both.

ESA has selected Claude Nicollier of Switzerland, Juergen Fein and Klaus Kramp of Germany and Michael Taylor of England as payload specialists. Nicollier and Taylor have each been designated for flight operations while Fein and Kramp will serve as ground backups.

The mission will be completed May 26. On May 30, the aircraft will be flown to Paris where it will be exhibited as configured for the ASSESS mission at the Paris Air Show. Following the air show, Galileo II will be flown to Cologne, Germany, where the ESA experiments will be removed.

- end -

April 20, 1977

NASA News

National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, California 94035
AC 415 965-5091

X May 4, 77

Larry King

ARC anno · For Release:
May 5, 1977

NOTE TO EDITORS:

Ten female volunteer test subjects will complete a month-long study on Tuesday May 10 which will help set medical standards for passengers on future space flights. The study included a nine-day period of total bedrest to simulate weightlessness and centrifuge rides to simulate reentry into the Earth's atmosphere.

A press conference to discuss results of the study is scheduled for 1 p.m., May 10, in Building 245 at NASA's Ames Research Center. Principal Investigator Dr. Harold Sandler, members of his staff, and the group of volunteers, will be available to the press at the briefing. The Ames bedrest facility will be open and available for inspection.

Volunteers who participated in the study are: Nance Lou Deardorff, Mary C. Gerbino, Wendy L. Heyman, and Christine Smith, all of San Jose; Gloria A. Martinez and Rita L. Mc Intire of Milpitas; Chrisula Asimos, San Francisco; Marion Hays, Alameda; Charlene D. "Kitty" Johnson, Montara; and Carol Pruit, Dublin.

For further information, please call the Ames Public Affairs Office, 415/965-5091.

5/4/77

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Peter Waller 415/965-5091

For Release:
THURSDAY,
June 9, 1977

Release No. 77-33

PIONEER 11 AGAIN CROSSING ORBIT OF JUPITER

NASA's Pioneer 11, bound for the outer reaches of the solar system, will cross the orbit of Jupiter for the second time on Friday (June 10).

The first passage occurred in December 1974, when the spacecraft flew past the giant planet itself. Jupiter's enormous gravity then "kicked" the spacecraft into a new orbit that will take it to ringed Saturn in September 1979.

Although the encounter course is not yet final, one possibility is that the spacecraft will pass between the rings of Saturn and the planet itself. Saturn's rings are 60,000 km (37,000 mi.) wide.

After passing Saturn, Pioneer will head out of the solar system, traveling roughly in the same direction as the solar system moves through the Galaxy. This is nearly opposite the path of Pioneer 10, Pioneer 11's predecessor, already on its way out of the solar system and now between the orbits of Saturn and Uranus.

- more -

June 6, 1977

Pioneer 11 has added greatly to our knowledge of Jupiter and the solar system. At Jupiter, in addition to getting important new data on the magnetic fields and radiation belts, Pioneer took the first look at the planet's polar regions (not visible from Earth) and the first closeup pictures of two of the four large Jovian moons, Io and Europa. During 1976, when Pioneer 11 was high above the ecliptic plane, data were obtained that greatly improved on our understanding of the structure of the Sun's magnetic field, a finding which will help us understand Sun-Earth relationships and their effects on climate. The new data are consistent with a less complicated internal structure for the Sun and stars.

The spacecraft's sister ship, Pioneer 10, is now almost 2 billion km (1.2 billion mi.) out from the Sun, between the orbits of Saturn and Uranus. It is penetrating deeply into unexplored space.

Pioneer 11 surpassed Pioneer 10's encounter speed of 131,000 km (82,000 mi.) per hour, reaching a speed of 171,000 km (107,000 mi.) as it passed the planet in December 1974.

Each Pioneer carries a plaque with a message for any intelligent species that may intercept the spacecraft during its endless journey through the cosmos.

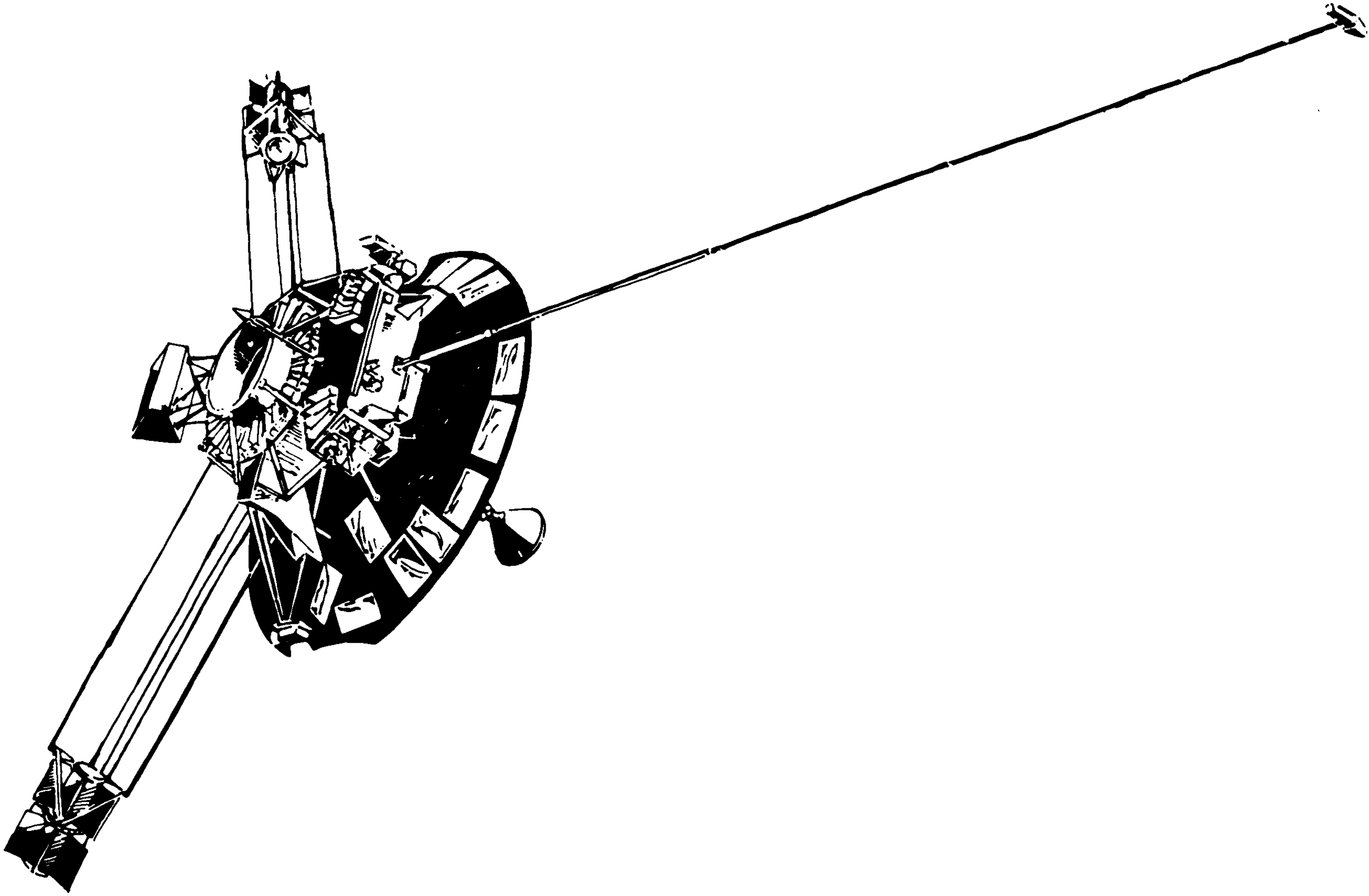
The Pioneer 10 and 11 project is managed for NASA's Office of Space Science by Ames Research Center, Mountain View, Calif. The spacecraft were built by TRW Systems, Redondo Beach, Calif.

- end -

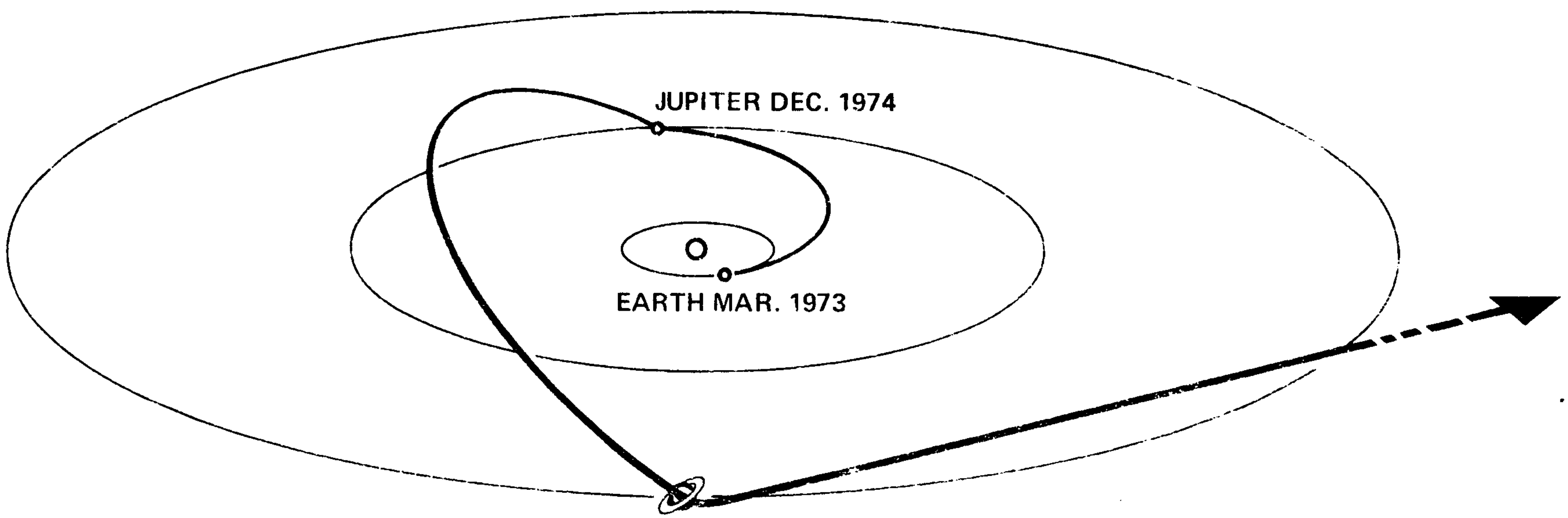
(See three drawings, attached.)

June 6, 1977

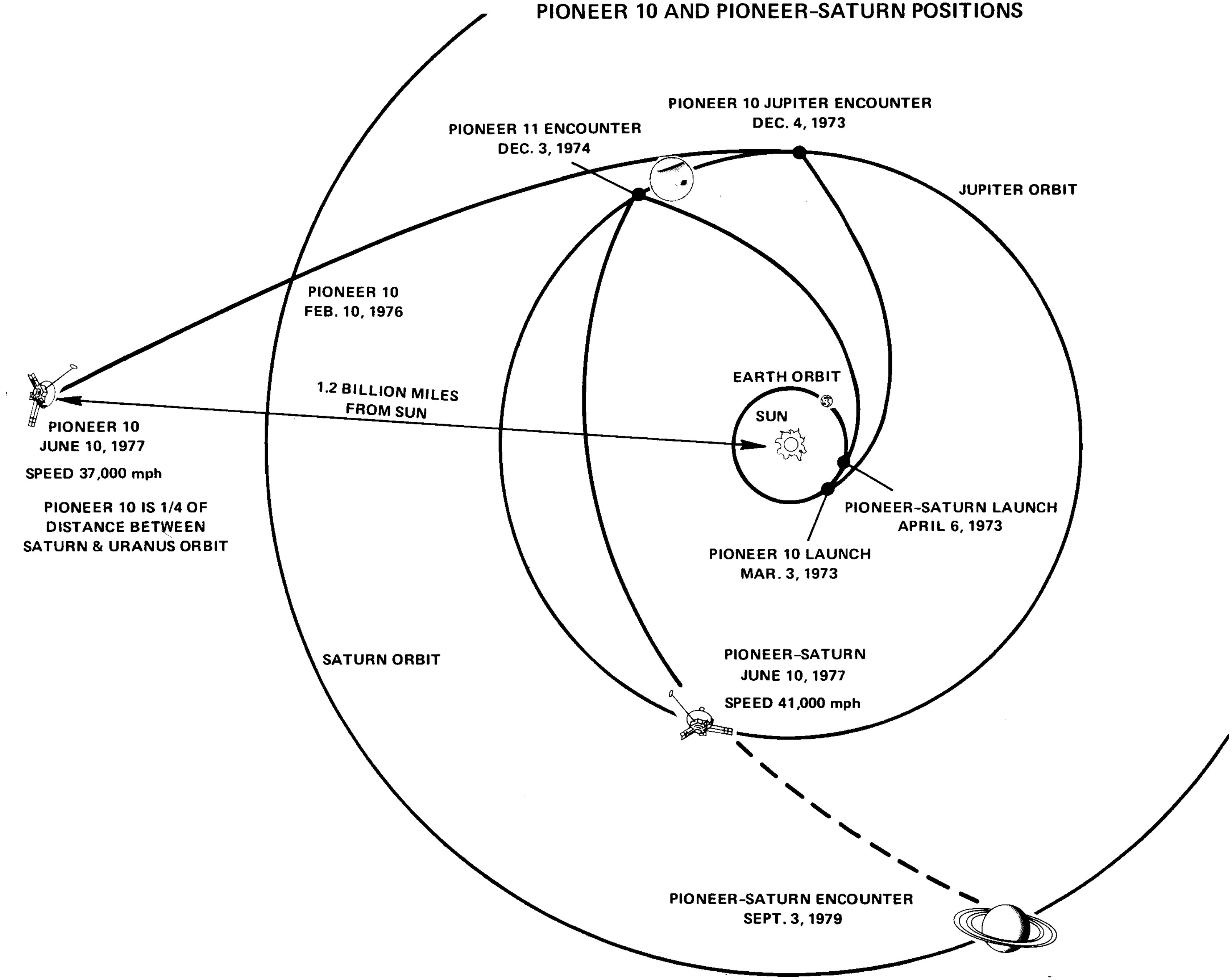
PIONEER-SATURN SPACECRAFT



PIONEER 11 FLIGHT PATH



PIONEER 10 AND PIONEER-SATURN POSITIONS



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Peter Waller 415/965-5091

For Release:
WEDNESDAY,
June 15, 1977

Release No. 77-33

DISC-SHAPED STAR WHICH MAY BE

FORMING PLANETS DISCOVERED

Discovery of a "disc-star" which may well be in the process of forming its own planets has been made by a University of Arizona-NASA Ames Research Center team.

The find marks the first discovery of probable planet formation in process, and is the first identification of a flat, disc-shaped, highly luminous stellar object.

The star, MWC 349, is in the constellation Cygnus, and is estimated to be only 1,000 years old. Its surrounding disc of intensely-glowing gas appears to have a diameter 20 times that of the central star, and to emit about ten times as much light as does the star. The disc at its outer edge is calculated to be about as thick as the star's diameter. Total brightness of the new stellar object appears to be declining about one percent a month as luminous material from the glowing disc spirals into the central star. Hence, the luminous disc is expected to be gone in about 100 years.

 June 10, 1977

The new star is about ten times the size and 30 times the mass of our Sun, and is expected to live only 100 million years. This is only 1/100th as long as our Sun, whose calculated life is ten billion years.

The discovery was made by a team of astrophysicists headed by Dr. Rodger Thompson, Steward Observatory, University of Arizona, Tucson. Team members were: Dr. Peter Strittmatter, Director of Steward; and Drs. Edwin Erickson, Fred Witteborn, and D. W. Strecker, all of NASA's Ames Research Center, Mountain View, CA.

Observations of the star were made with the 91 cm. (36 inch) infrared telescope of Ames' Kuiper Airborne Observatory, largest in existence, and the Steward 2.3 meter (90 inch) infrared telescope. The Kuiper airborne telescope saw the large portions of the infrared spectrum which do not penetrate the atmosphere and cannot be seen from Earth. The larger Steward telescope had better resolution. Both were needed for the discovery. Infrared observations were essential to see through the veil of dust shrouding the disc star.

The scientific team believes the significance of the find lies in the fact that planets may well be forming now in the luminous disc or have just formed in the gas outside the star's luminous disc. Characteristics of this rapidly-changing disc should shed light on planet-formation processes in our solar system, and around other suns.

June 10, 1977

Scientists do not have a satisfactory model to explain how planets form around Suns. Existing theories do agree that in formation of stars, rotating clouds of hydrogen and other elements contract due to gravity. The rotation produces a flat, spinning disc. Material in the disc is then believed to move toward the center, eventually piling up enough mass to ignite the nuclear fusion reaction which produces starlight. However, mechanics of the process of planet formation are not understood.

With MWC 349, astronomers believe they are now watching a star and planet-formation process as it happens.

It is believed that as a glowing stellar disc, like that of MWC 349, cools, planets condense out, first in the outer reaches of the gas cloud and then closer to the parent sun.

The luminous disc of MWC 349 is believed to be the inner part of a surrounding larger disc of non-luminous gas in which outer planets may already have formed. Superimposed on our solar system, this non-luminous disc would extend out beyond Pluto, the outermost planet. The luminous inner disc would reach out beyond the Earth's orbit.

The intensely luminous disc is wedge-shaped in cross section. It joins the star's glowing surface and its thickness there is about 1/40th of the star's diameter.

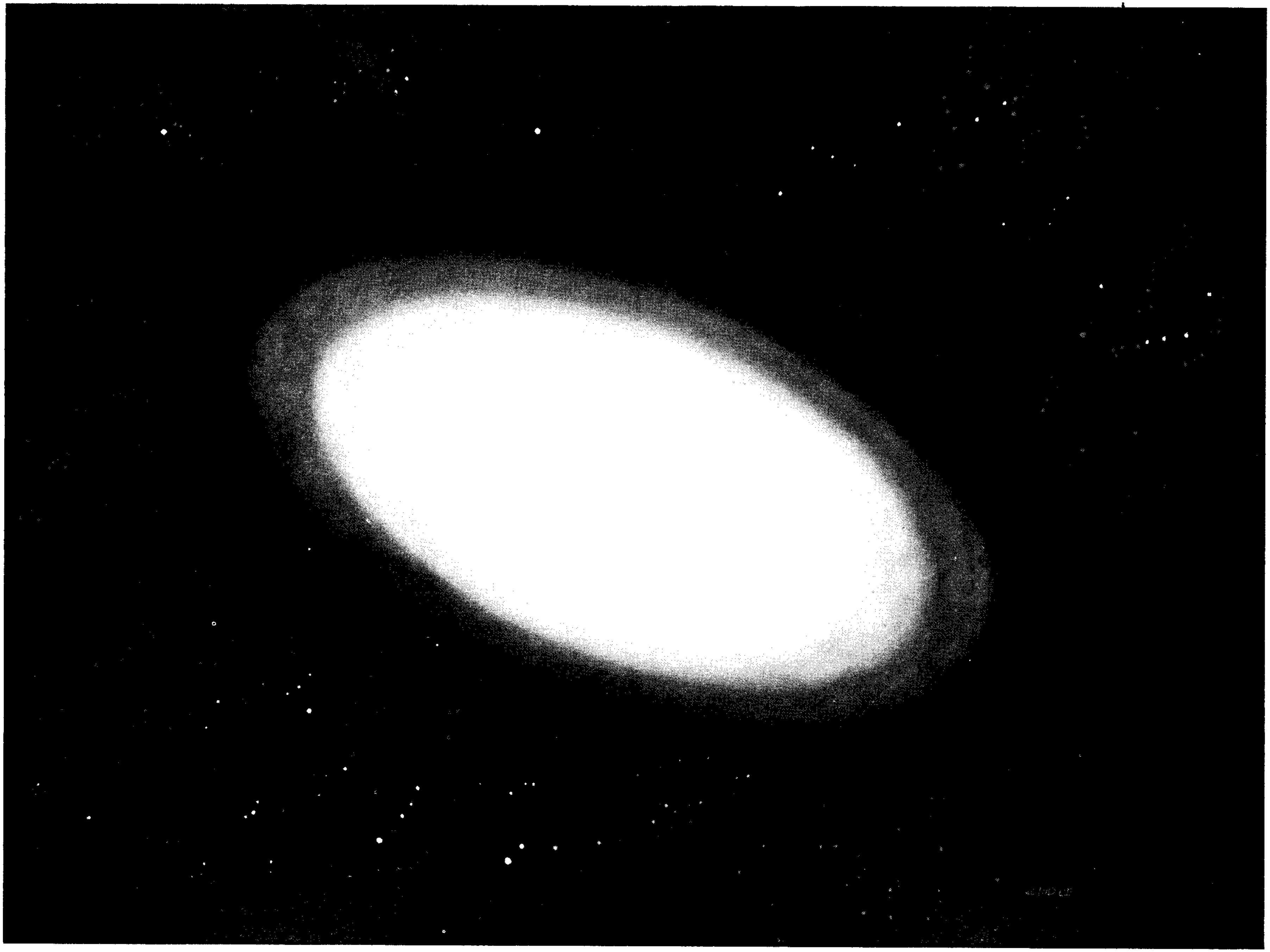
Light coming from the glowing disc is due to the frictional heat of the atoms of gas rubbing against each other. This friction also reduces the atoms' rotational speed around the parent star, causing them to spiral in to the star. Continuous loss of this luminous gas into the central star accounts for the one percent a month loss in brightness, and explains the calculated disappearance of light from the disc in around 100 years.

Dr. Thompson presented these findings at the American Astronomical Society meeting, Atlanta, GA this morning. The three basic pieces of evidence for the discovery are: that the star is much brighter in visible light wavelengths than it should be, that it has steadily lost brightness since its first identification in the 1930s, and that the spectrum of energy radiated is not that for a hot star. Instead its spectrum is that for a hot, glowing disc as predicted by English scientists Drs. Lynden-Bell and Pringle.

Since the star is thought to be about 10,000 light years away, all observed star events actually occured 10,000 years ago, the time required for its light to reach Earth.

- end -

June 10, 1977



AC77-0785

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Peter Waller 415/965-5091

For Release:

NOTE TO EDITORS:

The attached release announces discovery of a star in the shape of a brightly glowing disc--20 times wider than it is thick. If this were our Sun the white hot disc would engulf the Earth. This star may well be in the process of forming planets.

These are the first observations ever made of either a disc-star or likely planet formation in progress.

Simultaneous news conferences announcing the find will be held at 10 a.m. PST Wednesday both at Ames and at the American Astronomical Soceity meeting in Atlanta where the paper describing the work is being given.

The Ames briefing will be conducted by Ames' Dr. Edwin Erickson, co-investigator on the discoverey. A color painting of the star and color prints will be available as will the Kuiper Airborne Observatory, world's largest such facility, from which key observations were made.

News reporters should come to the NASA gate of Moffett Field and will be directed from there.

June 13, 1977

NASA News

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Stan Miller 415/965-5091
Public Affairs Officer

For Release:

NOTE TO EDITORS:

The 1977 Ames Summer Study on Space Settlements and Industrialization Using Non-terrestrial Materials is now in progress under the direction of Dr. Gerard O'Neill. Technical areas being addressed by the five teams engaged in the study are: the development of long-range plans for the ultimate design of closed or partly closed life support systems; a cost and design sensitivity study on habitats of varying sizes taking into account human physiological requirements; minimum-investment maximum-payback construction plans for space manufacturing; engineering of mass-drivers for the transport of lunar materials into space, of payloads from earth to lunar orbit, and for retrieval of asteroids; detection, orbital characteristics and retrieval scenarios for earth-crossing asteroids; and the processing of lunar or asteroidal material into useful products for the construction of large space structures.

A final briefing on the results of the Summer Study will be given by Dr. O'Neill and the study teams on Tuesday, August 2, in the Main Auditorium (Building 201) at Ames Research Center. The briefing is scheduled from 8:30 a.m. until noon.

Dr. O'Neill and other members of the study group will be available for interview after lunch. In addition, a 32-foot-long demonstration model of a mass-driver will be available and will be demonstrated for photographers.

Members of the press who wish to attend the briefing should proceed directly to NASA Gate 18 where they will be directed to the auditorium.

For further information call the Ames Public Affairs Office, 415/965-5091.

7/25/77

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For Release
IMMEDIATE

Release No. 77-37

U.S. EXPERIMENTS FLY ON USSR BIOLOGY SATELLITE

Seven American biological experiments have been successfully orbited and returned to Earth aboard the Russian Cosmos 936 Satellite. The Soviet biology satellite was launched August 3 from Plesetsk base in the USSR and returned its biology payload to Earth in Siberia by parachute on August 22, 19 days after launch. Cosmos 936 also carried biology experiments from France, Czechoslovalia, Poland, Romaina, Bulgaria, Hungary, and East Germany.

The U.S. portion of the mission is managed by NASA's Ames Research Center, Mountain View, CA. Its principal objective is to determine the effects of spaceflight on the physiology, biochemistry, genetics, longevity and morphology of selected biological specimens including rats and fruit flies. The findings will be applied to the problems of ensuring the health, safety and effective performance of man in space.

- more -

August 30, 1977

U.S. scientists are in Moscow for payload recovery, and are participating in the initial processing of experimental materials at the Institute for Biomedical Problems. After recovery, biological materials were processed in a mobile laboratory and returned to Moscow. Ground controls for the project were terminated there on August 26. U.S. experimenters will transport biological material back to the U.S. for further study arriving on September 2.

The U.S. scientists participating in the Cosmos 936 mission are: Drs. Jaime Miquel and D. E. Philpott of Ames Research Center (Effects of Weightlessness on the Genetics and Aging Process of Fruit Flies); Drs. H. A. Leon of Ames and S. A. Landan, V. A. Hospital, Syracuse, N.Y. (Effects of Weightlessness on Random Hemolysis and Lifespan of Red Blood Cells of Rats); Drs. Samuel Abraham and Chui Lin of Childrens Hospital Medical Center, Oakland, CA; Dr. H. P. Klein and C. M. Volkman of Ames (Analysis of Liver Tissue for Enzymes Involved in the Conversion of Carbohydrates to Lipids); Drs. E. M. Holton of Ames and D. J. Baylink of the V. A. Hospital, Seattle, WA (Quantitative Analysis of Selected Bone Parameters); Drs. E. V. Benton, R. P. Henke, D. D. Peterson, Allan Frank, and Ronald Cassou of the University of San Francisco (Radiation Dosimetry Experiment); Drs. D. E. Philpott and Gladys Harrison of Ames (Histologic and Ultrastructural Examination of Eye Tissue); Drs. J. P. Van Der Meulen, L. A. Chui, and Joan Higgins of the U.S.C. Medical Center, and K. R. Castleman of the

- more -

Jet Propulsion Laboratory (Muscle Fiber Analysis of Cosmos Rats). Mr. Kenneth A. Souza of Ames is manager of the U.S. Experiments on the Joint USSR/US Biological Satellite Project.

Five of the seven U.S. experiments are extensions of experiments flown on the first cooperative USSR/US biological satellite, Cosmos 782, launched in November, 1975. Four of the U.S. experiments have Soviet co-investigators and all utilize some degree of Soviet scientific and technical assistance.

Without the Soviet flight opportunity, U.S. biological spaceflight experiments would have to wait for flights of the Space Shuttle in the 1980's. The last U.S. biological research spacecraft launched was Biosatellite 3 in 1969.

- end -

August 30, 1977

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For Release
IMMEDIATE

Release No. 77-38

HANS MARK SWORN IN

AS AIR FORCE UNDER SECRETARY

Dr. Hans M. Mark, former Director of NASA's Ames Research Center, Mountain View, California, has been sworn in as Under Secretary of the Air Force by Secretary of Defense Harold Brown at the Pentagon, Washington, D. C. In addition to his wife, the ceremony was attended by his father, Professor Herman Mark of Polytechnic Institute, Brooklyn, New York, his brother, Professor Peter Mark of Princeton University and other friends and associates. The ceremony took place on Tuesday, August 9.

Dr. Mark was Director of the Ames Center for six years, from February 1969 until July 1977. Dr. Mark's research appointments include Massachusetts Institute of Technology, the University of California at Berkeley, and the Lawrence Radiation Laboratory at Livermore, California.

Dr. Mark has served as associate professor of nuclear engineering at the University of California at Berkeley,

- more -

Aug. 10, 1977

as consulting professor of engineering at Stanford University, and has taught undergraduate and graduate courses in physics and engineering at Boston University and Massachusetts Institute of Technology.

Dr. Mark is a member of the National Academy of Sciences Committee on Atomic and Molecular Physics. He is a fellow of the American Physical Society, and the American Institute of Aeronautics and Astronautics. He is also a member of Sigma Xi and Phi Beta Kappa.

Dr. Mark has been a consultant with the Institute for Defense Analyses (1958-61), the USAF Scientific Advisory Board (1969-76), and a number of other scientific and defense-related agencies.

He is co-editor of the book, The Properties of Matter under Unusual Conditions, and co-author of a textbook, Experiments in Modern Physics.

Dr. Mark was born in Mannheim, Germany, June 19, 1929. He came to the United States in 1940 and became a United States citizen in 1945. He and his wife, the former Marion G. Thorpe, of Hayward, California, have two children.

- end -

August 10, 1977

NASA News

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For Release:
IMMEDIATE

Release No. 77-40

INVESTIGATORS NAMED FOR JUPITER PROBE

Twenty-nine experimenters have been chosen for the atmosphere probe portion of NASA's Jupiter-Orbiter-with-Probe mission. The probe will carry six experiments deep into Jupiter's dense atmosphere.

Scheduled to become the first planetary spacecraft to be carried aboard NASA's Space Shuttle, JOP is designed to conduct the most detailed scientific investigation yet of Jupiter, its environment and moons, including the first direct measurement of the planet atmosphere.

The mission is composed of an orbiter which will circle the planet for at least 20 months and the atmosphere probe.

Although previous spacecraft have flown or will fly past Jupiter, JOP offers the first opportunity to make direct as well as remote measurements of the giant planet,

- more -

September 2, 1977

its environment and its planet-sized moons from various orbiting positions over a long period of time.

The basic mission as now envisioned will involve probe separation from the orbiter while the two spacecraft are approximately 55 days away from the planet. The two spacecraft will continue on separate flight paths until the probe enters the Jovian atmosphere and relays its data back to Earth via the orbiter. Approximately 30 minutes of data will be transmitted to the orbiter during the high speed descent.

Jupiter contains more than two-thirds of the planetary material in the solar system, more than all the other planets combined. Studies of its fast-spinning atmosphere may well help scientists understand Earth's weather and climate.

The JOP project will be managed by NASA's Jet Propulsion Laboratory, Pasadena, Calif. NASA's Ames Research Center, Mountain View, Calif., will manage the probe system.

After termination of the entry probe phase, the orbiter will fly close to the Jovian moon Ganymede and near the big moons Io, Europa, and Callisto.

* One hundred and fourteen scientific investigators have been selected for JOP, and 13 of these will have interdisciplinary tasks. They will aid in mission planning and in coordinating science investigations to assure the best overall mission results. The others will be assigned to 17 individual experiments.

 September 2, 1977

For the probe, there will be five interdisciplinary scientists, and 24 scientists assigned to the six atmosphere probe experiments.

The six instruments on the probe which will make direct measurements as it descends through the atmosphere of Jupiter, and Principal Investigators are:

- Helium interferometer. The instrument will measure with extreme accuracy the ratio of hydrogen to helium in the atmosphere.

The measurement is of significance to cosmology, since it helps scientists understand whether the universe is "closed" as the bit-band theory says, or open, as other theories say. Dr. Ulf von Zahn of University of Bonn, Federal Republic of Germany, will be Principal Investigator.

- Mass spectrometer. The instrument works in cooperation with the helium interferometer. The spectrometer will analyze the composition of the Jovian atmosphere. Dr. H.B. Niemann of NASA's Goddard Space Flight Center will be Principal Investigator.

- Atmospheric structure. By measuring deceleration of the probe as it passes through the atmosphere, scientists can measure atmospheric pressure and temperatures as they change with altitude. Dr. Alvin Sieff of Ames Research Center will be Principal Investigator.

• Nephelometer. The instrument studies clouds, particle sizes and locations in the atmosphere. Dr. Boris Ragent of Ames Research Center will be Principal Investigator.

• Net-flux radiometer. The instrument will measure energy radiated and received by Jupiter. (Jupiter appears to radiate 2.5 times the energy that it receives from the Sun.) Dr. R.W. Boese of Ames Research Center will be Principal Investigator.

• Sferics receiver. The instrument will measure radio static generated by lightning discharges in Jupiter's atmosphere, and will also be able to detect the light given off by lightning flashes. Dr. L.J. Lanzerotti of Bell Laboratories will be Principal Investigator.

Dr. Lawrence Colin of Ames Research Center will be Probe Project Scientist.

- end -

September 2, 1977

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Peter Waller 415/965-5091

For Release:
Oct. 14, 1977
p.m. papers

Release No. 77-43

MAJOR STEP IN ORIGIN OF LIFE FOUND

A major breakthrough in explaining the origin of life appears to have been made by a team of scientists at NASA's Ames Research Center, Mountain View, CA.

The work appears to show how building blocks of life were collected and organized on the shores of the primordial oceans by "natural catalysts" found widely on Earth. This would be a step in the chemical evolution of the first living organisms.

The experiments seem to demonstrate how two basic types of life molecules (amino acids, the building blocks of protein, and nucleotides, the building blocks of the life-directing DNA molecule) were concentrated in the primitive oceans. The work also seems to show how non-life amino acids were selectively destroyed, and how life-related amino acids were linked together in these ancient oceans into the chains needed to make living cells.

- more -

October 11, 1977

The question of how random collections and small amounts of life building blocks could be concentrated so that they could produce living organisms, has been unsolved for many years. Team leader for the work was Dr. James Lawless of Ames, along with Dr. Nissim Levi, a National Research Council Fellow from Israel, working at Ames. Their collaborators were Dr. Daniel Odom. now at the University of Houston, and Ms. Kristi Kjos, and Mr. Randy Mednick, both students at the University of Santa Clara, working at Ames. Dr. Lawless gave a paper reporting on the work at the Pacific Conference on Chemistry, in Anaheim, CA today.

Most scientists accept the theory that life began by chemical evolution on the shores of the primitive oceans. The theory says that various forms of energy such as lightning, heat, and ultraviolet radiation converted the abundant, carbon-containing ammonia, methane, and water of the primitive earth into building blocks of life (organic molecules). These molecules, according to the theory, then joined together into ever-more complex molecules until a molecule or group of molecules appeared which could replicate itself. This was the first living thing.

In recent years, many scientists have performed a very large number of chemical evolution experiments.

These have produced most of the basic life molecules (including amino acids and nucleotides) in small quantities, by applying electric discharges or other energy release to ammonia, methane, and water. But until now scientists have been unable to explain how the life building blocks in the primordial oceans were organized.

The newly-found mechanism involves substances which would have been common on the shores of the primitive oceans--metal-clays. Clays had to be widely spread on the primordial Earth and ocean shores; and, by definition, all clays contain metals. Metal salts would be found in the oceans. When low-concentration solutions of amino acids were mixed with the commonplace metal-clays, Dr. Lawless's team found that all clays attract amino acids (of which there are about 1,000 different kinds) out of solution. One metal-clay (nickel containing) preferentially attracts the 20 amino acids which make protein, the main structural ingredient of living cells. Nickel-clay is a very abundant Earth material. Of eight metal-clays tried, only nickel-clay does this.

Dr. Levi reported that the other clays destroy non-protein-forming amino acids faster than protein amino acids. Thus, a realistic mechanism for the concentration and selection of the life forming amino acids has been found.

- more -

October 11, 1977

Experiments simulating tidal action on the clays (i.e., dry an amino acid-clay solution, warm it, wet it again and repeat the process several times) produces chains of amino acids (eight amino acid molecules linked together, so far). Presumably, time would produce the far longer chains found in life.

A metal-clay had a similar effect on the building blocks of DNA. (The very-long-chain DNA molecule in every living cell, including human ones, contains a blueprint of the entire organism.)

DNA building blocks are concentrated by zinc-clays. Only the zinc one, of the nine metal-clays tried, did this.

A further signifigant fact is that zinc is known to play an important role in the enzyme, DNA ploymerase, which performs the task of linking DNA building blocks (nucleotides) in living cells. Enzymes are super-catalysts, which drastically speed-up many life processes.

Dr. Lawless believes that the key role of metals in many biological processes is a result of having had a lot of metals present since the beginning of the life process, and that the presence of metals in living systems today results from early prebiological chemistry.

- end -

October 11, 1977

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Peter Waller 415/965-5091

For Release:
Thursday, November 17, 1977

Release No. 77-45

THE BEGINNING: SERENE PROCESS OR CHAOTIC BANG?

Was the Big Bang explosion that marked the beginning of our universe violent and chaotic?

Many scientists think so.

But measurements made recently by a team of researchers using a high flying NASA aircraft suggest that our cosmos may have started more serenely--with a powerful but tightly controlled and completely uniform expansion.

Using ultrasensitive radio equipment aboard an Ames Research Center U-2 jet, the research team measured the cosmic microwave background--the radiation left over from the Big Bang, the initial, universe-forming event--and concluded that this initial event was a very smooth, almost serene process, with matter and energy uniformly distributed and expanding at an equal rate in all directions.

The findings were made by Drs. Richard Muller, George Smoot and graduate student Marc Gorenstein of the Lawrence Berkeley Laboratory and the University of California at Berkeley, who also designed and operated the radio equipment.

- more - November 4, 1977

They also found that the Milky Way Galaxy, together with the Solar System and Earth, are hurtling through space at more than one million miles per hour towards the constellation Hydra. "The radiation left from the universe-forming event, about 15 billion years ago, is so uniform that it provides a universal reference for measuring this motion," says Gorenstein.

"The large scale regularity we have found in the expansion of the universe makes the million-mile-an-hour random local motion we have discovered for the Earth and our galaxy all the more surprising," says Muller.

"Another major surprise is that the U-2 measurements seem to show that there is no rotation of the universe," says Smoot. "This, is surprising because we can see that everything within the universe is rotating--planets, stars, and galaxies. If there is rotation, it has to be less than one hundred-millionth of a rotation in the last billion years."

"Our measurements give a picture of an extremely smooth process," declare the researchers. "The big bang, the most cataclysmic event we can imagine, on closer inspection appears finely orchestrated. Either conditions before the beginning were very regular, or processes we don't yet know about worked to make the universe extremely uniform," says Dr. Smoot. This uniformity was greater than one part in 1,000 for matter, one part in 3,000 for energy, and one part in 10,000 for expansion.

According to the currently accepted "big bang" picture, the universe began as a hot, incredibly dense mass containing all the matter in the universe. At a certain "initial" instant, the primeval fireball exploded in the vastest cataclysm imaginable.

As the universe continued its expansion and the temperature dropped, protons and neutrons began to fuse into nuclei. The nuclei combined with electrons to form hydrogen, deuterium and helium. After millions of years, the material had cooled sufficiently to condense into galaxies and within the galaxies into stars and planets. As a consequence of the colossal explosion, the galaxies have continued to separate from each other, and thus form the expanding universe we observe. Those galaxies farthest from Earth appear to be traveling the fastest.

The cosmic microwave background radiation was discovered in 1965, and is now widely believed by scientists to be a remnant of the cataclysmic explosion which marked the beginning of time some 15 billion years ago. The radiation is believed to have originated in the intensely hot plasma that existed for the first million years after the Big Bang. Initially far more intense than the fireball of an atomic explosion, the radiation has greatly weakened with the passage of time. Scientists study it in an effort to find clues about the nature of matter and energy on its grandest scale.

The radiation can be employed to measure motion of the Earth by using the Doppler effect. Radiation in front of a moving Earth shifts toward the hotter blue side of the spectrum; that behind the Earth to the colder red side.

The plane, at an altitude of 65,000 feet, flies above 90 percent of the Earth's atmosphere where these sensitive experiments must be conducted. In charge of the flights for NASA's Ames Research Center, Mountain View, Calif., was James Cherbonneaux, U-2 Project Manager. When it is not investigating the cosmos, the U-2 jet is used for agricultural and Earth resources photography.

The project was funded by the Department of Energy and NASA. Measurements so far have covered almost the entire sky over the Northern Hemisphere, half the Celestial Sphere.

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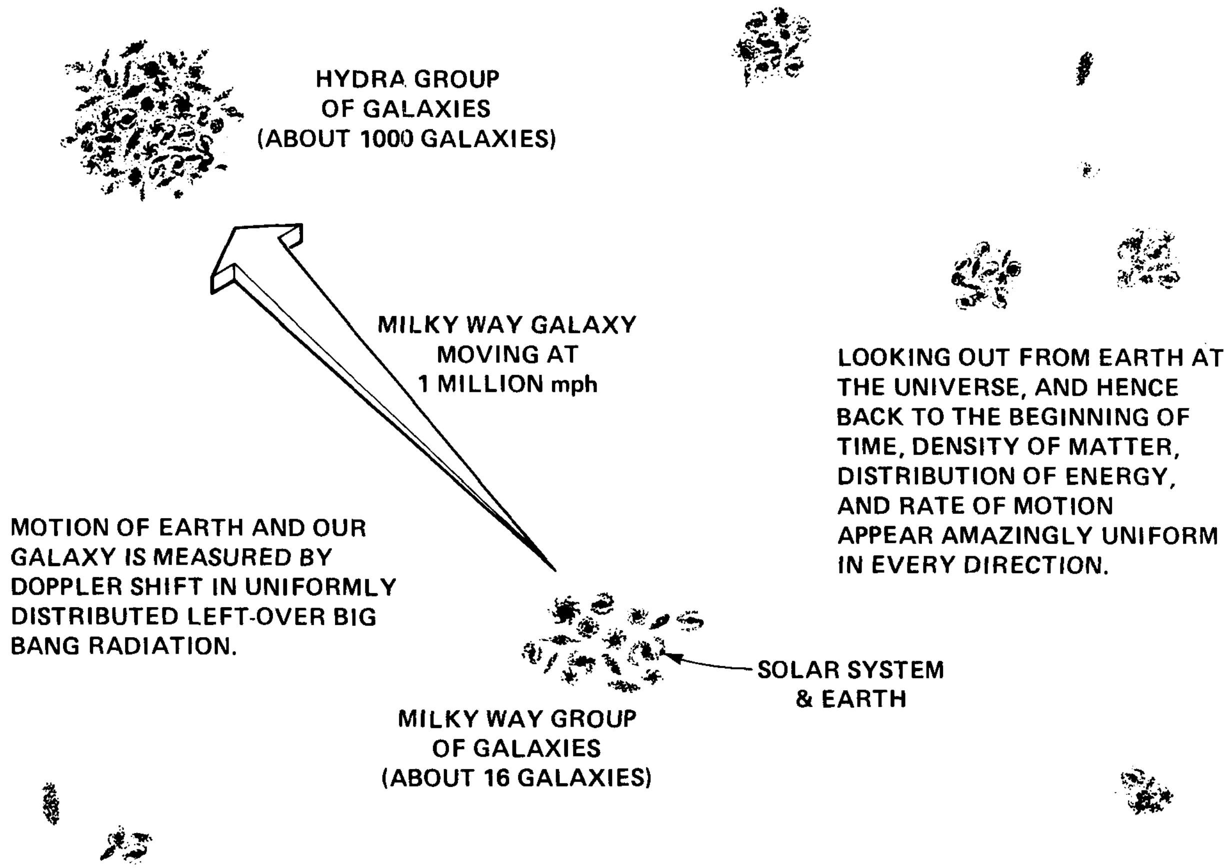
November 4, 1977

SCHEMATIC VIEW OF OUR SECTOR OF THE UNIVERSE



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For Release:
IMMEDIATE

Release No. 78-10

NASA AWARD TO CELL EXPLORER

Knowledge of how cells get the energy to shuttle nutrients across their outer membranes has won for its discoverers a top NASA prize. Dr. Janos K. Lanyi of the Extraterrestrial Biology Division at NASA's Ames Research Center near Mountain View will be awarded the 1978 H. Julian Allen Award, Monday, April 10. The award honors the author of the best scientific paper published by an Ames researcher.

Sharing the award is Associate Professor Dr. Russell E. MacDonald of Cornell University who has collaborated with Dr. Lanyi since Dr. MacDonald visited Ames in 1974.

Although the researchers experimented with primitive bacteria found in San Francisco Bay Area salt flats, evidence is rapidly accumulating that the same cellular pumping mechanisms they discovered are at work in human cells, as well.

- more -

April 6, 1978

This new knowledge is essential to understanding basic human biological activities such as nerve conduction and food assimilation, processes dependent on membranes efficiently transporting molecules in and out of their cells.

Dr. Lanyi originally worked with Halobacterium halobium, a bacterium whose special pigment, bacteriorhodopsin, contributes to reddish color of San Francisco Bay Area salt flats. Bacteria utilize bacteriorhodopsin in their membranes to turn sunlight into energy and food, much like green plants use chlorophyll.

Using new laboratory techniques he developed for isolating cell membranes in the form of microscopic vesicles, Dr. Lanyi showed how sodium ions and amino acids (the basic units of proteins) are pumped into the cell. Bacteriorhodopsin uses solar energy to drive positively charged hydrogen ions (protons) across the membrane. This creates an energy-yielding electrical gradient, which sets up a similar gradient of sodium ions. Dr. Lanyi found it is the sodium gradient that provides the energy to pump amino acids into the cell.

H. Halobium is related to bacteria thought to have evolved early in the history of life on Earth, and Dr. Lanyi's discoveries may represent a model of how bacteria first used light energy to acquire molecules from the environment it could not make. Dr. MacDonald then showed similar sodium ion gradients at work in other bacteria, including E. Coli, found in man and used as a standard research "bug" for investigating basic cellular activities.

In recognition of his research, Dr. Lanyi was awarded the NASA Medal for Exceptional Scientific Achievement in December, 1977. His work at Ames' Extraterrestrial Biology Division is part of studies of earth organisms which live in extreme environments such as those expected on other planets.

The H. Julian Allen Award will be presented to the co-recipients in Ames' Main Auditorium at 1:30 p.m. Following the ceremony, Dr. Lanyi will give a lecture on his research.

- end -

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Stan Miller 415/965-5091

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Release No. 78-16

SYVERTSON NAMED AMES RESEARCH CENTER DIRECTOR

Clarence A. Syvertson, Deputy Director of Ames Research Center, Mountain View, Calif., has been named Director of the center, effective April 30, 1978.

Syvertson has been Acting Director at Ames since the resignation of Dr. Hans Mark in August 1977 to become Under Secretary of the Air Force.

In 1948, Syvertson began his career with NASA's predecessor agency, the National Advisory Committee for Aeronautics, as a research scientist and assistant branch chief at Ames.

He became Chief of the 3.5-foot Hypersonic Wind Tunnel Branch in 1959 and from 1963 to 1966, he was Director of the Mission Analysis Division. In 1966, he was named

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April 26, 1978

Director of Aeronautics at Ames, the position he held until being appointed Deputy Director of the center in February 1969.

Syvertson served a year-long detail in 1970-71 with the Department of Transportation in Washington, where he was Executive Director of the Joint DOT-NASA Civil Aviation Research and Development (CARD) Policy Study, for which he received the NASA Exceptional Service Medal in 1971. Earlier awards include the Lawrence Sperry Award from the American Institute of Aeronautics and Astronautics and the Space Act Invention Award (shared with three others). He was named a Fellow of the American Institute of Aeronautics and Astronautics in 1976.

A native of Minneapolis, Minn., Syvertson received his bachelor of aeronautical engineering degree from the University of Minnesota in 1946 and a master of science degree there in 1948. He was graduated from the Advanced Management Program of Harward Business School in 1977.

He and his wife and daughter make their home in Saratoga, California.

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April 26, 1978

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Release No. 78-21

PIONEER VENUS 1 OPERATING WELL, TO MAKE COURSE CHANGE

Pioneer Venus 1 is right on course toward its orbit around Venus next December. Most engineering systems and the six interplanetary experiments now have been checked out and are operating normally.

"Performance so far has been extremely good," said Marshall Johnson, Venus Orbiter Flight Director at NASA's Ames Research Center, Mountain View, CA. "Of course, we have 300 million miles and six months to go," he added.

At 9 a.m. PDT Thursday, June 1, the spacecraft was 4,800,000 km (2,980,000 miles) from Earth, traveling toward Venus at 16,580 kph (10,296 mph.).

Controllers will make the first mid-course correction Thursday changing velocity by 12.6 kph (7.8 mph) to aim Pioneer toward the exact point for Venus orbit insertion.

- more -

May 30, 1978

Since a near-perfect launch on May 20, 1978 from Cape Canaveral, Florida, controllers at NASA-Ames have deployed the craft's long, 14-foot magnetometer boom, "despun" the high-data-rate, four-foot-diameter dish antenna to center it continuously on the Earth. They have taken four pictures of a "crescent Earth", turned on six interplanetary experiments, made a star map, and checked out spacecraft power, navigation, and propulsion systems. In all cases, systems are operating well.

Pioneer Venus 1 will be the first prolonged orbiter of the cloud-shrouded planet.

When it reaches Venus this December, along with the five atmosphere entry craft of Pioneer Venus 2, it will be a major part of NASA's six-spacecraft effort to understand the weather of Venus.

These planet-wide measurements from inside and outside Venus's atmosphere by the Pioneer Venus orbiter and atmosphere probes should provide a profile of Venus's very simple weather machine. Scientists believe this information may help with understanding the forces that drive Earth's complex weather and climate.

Pioneer Venus 1 will return daily pictures of Venus's 4-day cloud circulation. It will make radar maps of the planet's surface in Venus's unexplored hemisphere, which is

- more -

never visible from Earth at Venus closest approach. The Venus Orbiter will determine the bright planet's internal density distribution and global shape. It will measure Venus's atmosphere at many levels.

Pioneer Venus 1 measured the Earth's protective magnetic envelope, the magnetosphere, as it passed outside of it, as well as solar wind-Earth phenomena during the current turbulent sun period. Scientists report that the spacecraft's gamma ray burst detector may have seen a burst. These recently-discovered mysterious bursts, about 12 a year, have tremendous energies and come from somewhere in the cosmos.

Remaining tasks for the spin-stabilized Pioneer spacecraft are spinup from five to 15 rpm, and a second course correction in several weeks. Controllers also will turn on and check out experiments to be used only in Venus orbit.

The Pioneer VEnus project is managed by the Ames Research Center. The spacecraft was built by Hughes Aircraft Co., El Segundo, CA.

- end - May 30, 1978

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Peter Waller 415/965-5091

For Release:
Friday, A.M.
June 16, 1978

Release No. 78-25

KEY MECHANISM IN ORIGIN OF LIFE APPARENTLY FOUND

Scientists working for NASA apparently have discovered a way to account for the formation on Earth about four billion years ago of nucleic acids, one of the two most essential components of life.

The discovery supplements recent work in which the same investigators discovered a mechanism to explain the formation of the other critical component of life, protein.

Taken together, the findings provide an answer to a vital question that for years has puzzled theorists on the chemical evolution of life on our planet.

Basically, the mystery has been:

- How could the building blocks of life---randomly scattered on the shores of primitive oceans---be continuously collected and organized over millions of years in high enough concentrations to produce living organisms?

- more -

June 12, 1978

The scientific team which conducted the investigations at NASA's Ames Research Center, Mountain View, Calif., near San Francisco, consisted of Dr. James Lawless, team leader, of Ames; Dr. Edward Edelson, a National Research Council Associate, and Lewis Manring, a student at the University of Santa Clara.

The newly-found mechanism involves substances which would have been common on the shores of Earth's primitive bodies of water---metal-clays. When low-concentration solutions of DNA-forming nucleotides were mixed with commonplace metal-clays, Dr. Lawless's team found that most clays attracted them. The very long DNA nucleic acid chain in every living cell contains a blueprint of the entire organism.

Furthermore, one type of metal clay, containing zinc, preferentially attracts all six of the building blocks of DNA and RNA (nucleotides). Especially significant is the fact that zinc-clay attracted 97 percent of nucleotide 5-prime-adenosine monophosphate (AMP). AMP is the most common DNA building block in living systems. Further, AMP with slight modification becomes ATP, the basic energy molecule, present in every life form.

The role of zinc-clay is espcially interesting because zinc plays an important role in the enzyme, DNA polymerase, which performs the task of linking DNA building blocks (nucleotides) in living cells to make DNA chains. Enzymes are super-catalysts, which drastically speed up many life processes.

The group did another experiment. The most common DNA nucleotide, 5-prime-adenosine monophosphate (AMP), is composed of three chemical units---a sugar, a purine base and a phosphate group. Three forms of the nucleotide are theoretically possible: a "2-prime" form, a "3-prime" form, and a "5-prime" form, the three differing only in the position of the sugar ring to which the phosphate group is attached. However, only one of these forms is found in living organisms, the "5-prime" form. Dr. Edelson reported that zinc-clay preferentially attracts the "5-prime" form over the "2-prime" and "3-prime" forms.

The work appears even more significant in light of earlier results from Dr. Lawless' group which showed that metal-clays could effectively concentrate amino acids, the building blocks of proteins, and could catalyze their reaction to form polypeptide chains, the basic structual units of proteins. In addition, it was found that certain metal-clays could preferentially attract those amino acids found in the protein of living things today.

Most scientists accept the theory that life began by chemical evolution on the shores of primordial bodies of water. The theory says that various forms of energy such as lightning, heat and ultraviolet radiation converted the abundant carbon-containing methane, ammonia, and water of the primitive atmosphere into building blocks of life (organic molecules). These molecules, according to the story, then rained into primordial lakes and oceans and joined together into ever-more complex molecules until a molecule or group of molecules appeared which could replicate itself. This was the first living thing.

In recent years, many scientists have performed a large number of chemical evolution experiments. These have produced most of the basic life molecules (including amino acids and nucleotides) in small quantities, by applying electric discharges or other energy release to ammonia, methane, and water vapor. But until now, scientists have been unable to explain how the life-building blocks in the primordial waters were organized.

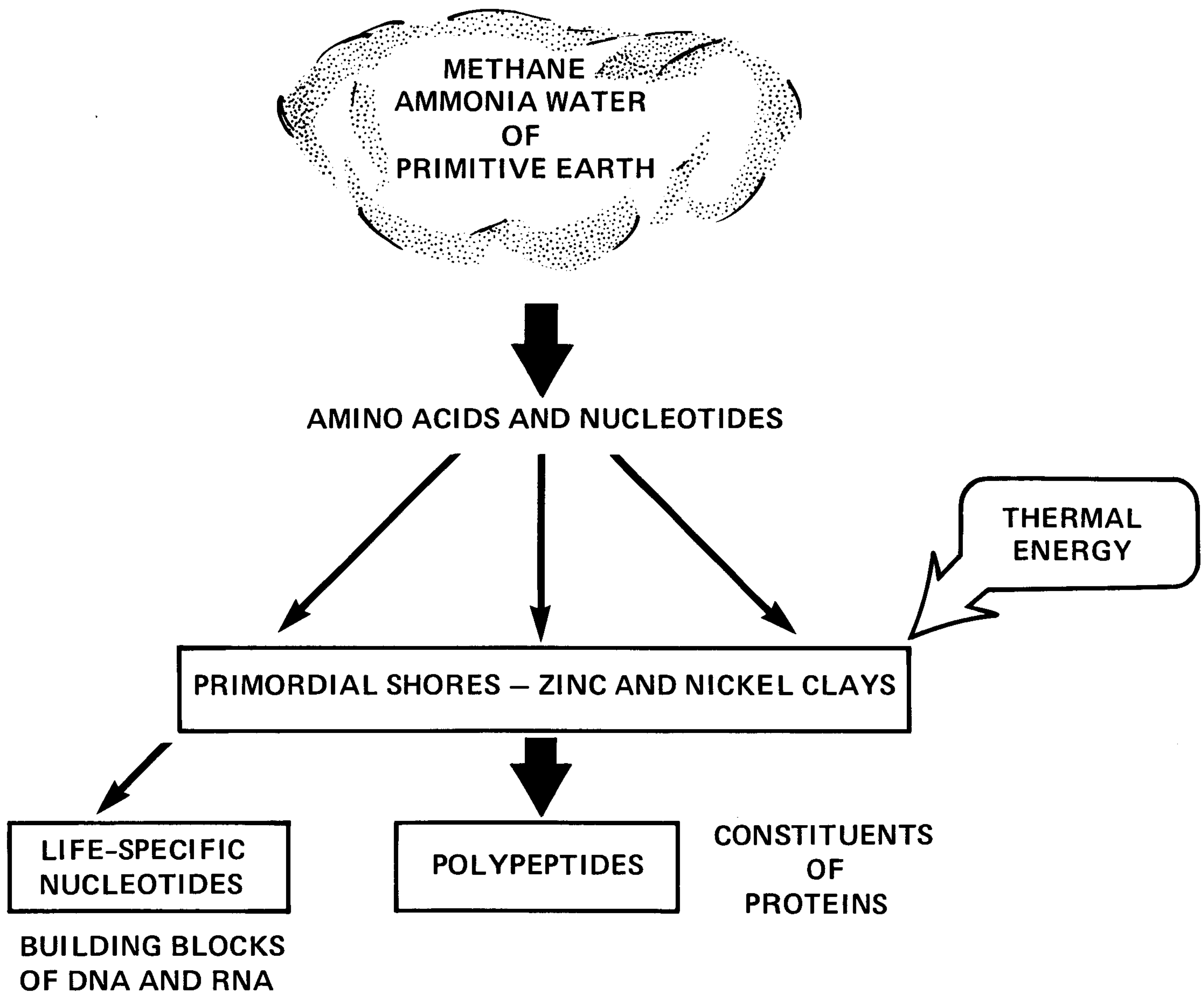
The group is doing further experiments to see if the zinc-clay preference for the "life-form" of this DNA building block applies to the five others. They are also trying to demonstrate the ability of clays to link up nucleotides into polynucleotides, the next step toward forming a DNA-like molecule.

Dr. Edelson reported on the work yesterday (June 15) at the 33rd annual northwest regional meeting of the American Chemical Society in Seattle, Wash.

- end -

June 12, 1978

SYNTHESIS OF POLYPEPTIDES AND CONCENTRATION OF NUCLEOTIDES



Edelson

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IMMEDIATE

Release No. 78-32

PIONEER 11 FINAL TARGETING FOR SATURN

Mission controllers have completed final course targeting for Pioneer 11's encounter with Saturn September 1, 1979, man's first visit to the giant ringed planet.

Spacecraft controllers at NASA's Ames Research Center, Mt. View, Calif., report Pioneer 11 is now locked onto a trajectory that will bring it to within 30,000 km (18,000 mi) from the edge of Saturn's outer ring. The spacecraft will then swing under the plane of the rings to 25,000 km (15,000 mi) from the planet's surface.

Pioneer 11 will take the first close-up color pictures of Saturn and its rings and make other first time measurements of the planet's magnetic field, atmosphere and other features.

The spacecraft will also pass within 350,000 km (210,000 mi) of Titan, one of Saturn's 10 moons, taking the

- more -

July 20, 1978

first close up pictures of it. Titan is the largest satellite of any planet (also larger than the planet Mercury) and the only moon with a substantial atmosphere, and possibly life.

Without the course correction, Pioneer 11 would have flown by Saturn at a much greater distance (100,000 km--60,000 mi) from the planet's surface. "We're going as close as we dare," said Jack Dyer, chief of mission analysis at Ames. Getting any closer to the ring edge would risk impact with orbiting fragments in the planet's ring plane.

From data transmitted by Pioneer to NASA tracking stations, it appears the spacecraft responded perfectly to a day long series of commands to alter its trajectory. The course maneuver involved a series of timed rocket thrusts which nudged the spacecraft away from Earth and onto its desired flight path.

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July 20, 1978

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75th ANNIVERSARY OF POWERED FLIGHT * 1903-1978 *

Peter Waller 415/965-5091 (Home 493-9406)

Release No. 78-48

For Release:
Monday,
Oct. 9, 1978

VENUS-BOUND PIONEERS

PASS CRITICAL TESTS

The two Pioneer spacecraft en route to Venus--the Orbiter and the Multiprobe--have passed major planet operations tests.

Aboard the Multiprobe spacecraft, Pioneer Venus 2, orientation, timing and separation systems have been tested for the split-second release of three probes to spread them over Venus' Earth-facing hemisphere 9600 km (6000 mi.) apart.

On the Orbiter spacecraft, Pioneer Venus 1, systems for the essential retrofire and injection-into-orbit maneuver (which takes place behind the planet and out of communication with the Earth) have been operated or tested.

The separate operations teams for the two spacecraft, at NASA's Ames Research Center, Mountain View, CA, have sent 6400 commands to the Orbiter since launch on May 20--and 3600 commands to the five atmosphere entry craft

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October 9, 1978

which make up the Multiprobe spacecraft, since its August 8 launch. Twenty days and 13 million km (8 million mi.) from the planet the Multiprobe splits into the transporter Bus and four probes.

The Multiprobe now has covered 140 million km (87 million mi.) on its 325 million km (200 million mi.) flight path to Venus. The Orbiter has covered 325 million km (202 million mi.) of its longer 500 million km (310 million mi.) flight path. Both spacecraft still have about 180 million km (112 million mi.) to travel before reaching Venus. The Orbiter arrives on Dec 4, the five entry probe craft on Dec. 9.

The two Pioneers and their 30 experiments are expected to improve understanding of Venus' simple weather machine and this should help us understand the forces that drive Earth's weather.

Virtually all experiments and systems on each of the five entry craft of the Multiprobe now have been operated and are working well. These include thermal, orientation, command, communications, and data return and power systems--a well as separation systems for the 90 kg (200 lb.) smaller probes.

This critical separation will allow launch from the spinning transporter Bus of these three entry probes at precise positions in space and within milliseconds of each other to send the probes to carefully-selected atmosphere entry points on Venus. The three probes separate from the Bus on Nov. 19 and enter the atmosphere Dec. 9. They are known as the North, Day and Night Probes. The Day Probe enters in Venus' southern hemisphere on the planet's day side, the Night Probe in the night southern hemisphere, and the North Probe in the North Polar Vortex, also on Venus' night side.

Controllers at Ames are also well along with operations for separation of the large 300 kg (700 lb.) Sounder Probe from the transporter Bus on Nov. 15, four days before smaller probe separation. Navigation maneuvers for the Sounder probe to enter Venus' atmosphere near the equator on the day side also have been tested, as have those for Bus entry in the day side southern hemisphere.

On the Orbiter spacecraft, all instruments have been checked and calibrated. Most of the Orbiter operations systems have been tested and are in good shape including systems for insertion of the Orbiter into orbit on Dec. 4, 1978.

The six Orbiter interplanetary experiments are gathering data during the current period of mounting solar activity. On September 23, they measured high solar wind speeds and other phenomena from a major storm on the Sun. The Orbiter's "camera" experiment, the Cloud Photopolarimeter, will begin measuring light from Venus on Tuesday, October 10. It will return the first pictures of Venus on its second orbit on Dec. 5.

- more -

The Orbiter will be placed on its 24-hour orbit around Venus by a 30-second burn of its 4000-lb.-thrust rocket engine. This will reduce velocity by 3953 kph (2456 mph). A detailed final test of the orbit injection sequence is planned Oct. 30. The numerous events of the complicated orbit zero, which immediately follows the orbital rocket burn were successfully simulated in detail on Sept. 19. Controllers plan a second orbit operations test for Oct. 17.

On Wednesday, Oct. 4, controllers successfully completed the first test of the X-band radio system in conjunction with the regular S-band system of the Orbiter. Comparisons of X- and S-band frequencies will allow scientists to make more exact radio studies of Venus' atmosphere when the Orbiter passes behind the planet.

On Friday, October 6, Multiprobe controllers did further tests of experiments on the large Sounder Probe, and on Oct. 12 of probe mission operations with the Deep Space Network stations in Spain, Australia, and California. On October 19, controllers will turn the Multiprobe 90° so that its aft-mounted medium gain, horn antenna faces Earth. This antenna will be used during the difficult probe separation maneuvers.

This Thursday, Oct. 12, controllers will do an entry operations test, and on Oct. 31 a final Sounder Probe navigation test. They also have tested probe experiments during simulations of the communications blackout during atmosphere entry.

On Friday, Oct. 6, the Orbiter was 34.4 million km (21.4 million mi.) from Earth, traveling away from Earth at 7580 km/hr. (4700 mph). The Multiprobe was 13.5 million km (8.4 million mi.) from Earth traveling away at 10,630 km/hr. (6600 mph).

The Pioneer project is managed by NASA-Ames. The spacecraft are built by Hughes Aircraft Company

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October , 1978

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75th ANNIVERSARY OF POWERED FLIGHT * 1903-1978 *

Peter Waller 415/965-5091

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Release No. 78-50

EFFECTS OF COSMIC RAYS ON PIONEER VENUS SPACECRAFT ARE MINIMAL

NASA scientists have devised procedures to minimize the effects of uncommanded changes in the computer memories aboard two spacecraft headed for Venus.

The bit changes in the command memories on Pioneer Venus 1 and 2 are believed to be caused by cosmic ray impacts on the solid state devices in the memories. The impacts do not damage the memories and the desired commands can be restored.

All commands and time delays in the spacecraft memories are in binary code (sequences of 1s and 0s), and the high-speed atomic nuclei, which are cosmic rays, occasionally cause a data "bit-flip," changing a 1 to a 0, or 0 to 1. This can change one command into another or change duration of a time delay. The Pioneer Venus Orbiter, Pioneer Venus 1, has experienced 16 "bit-flips"; the Multiprobe Spacecraft, Pioneer Venus 2 has had five.

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October 30, 1978

The Pioneer Venus Orbiter is scheduled to arrive at Venus on December 4. On December 9, the five atmosphere entry craft, which make up Pioneer Venus 2 will begin their descent into the atmosphere of the cloud-shrouded planet.

These craft are the larger Sounder Probe, and the three identical North, Day, and Night Probes. The Probes are designed to measure directly Venus' dense atmosphere from top to bottom. The Probes are not designed to survive impact on the surface at points 10,000 km (6000 mi) apart, but may return some surface data. The transporter Bus becomes a fifth probe and also enters the atmosphere.

Time counters for the four Probes cannot be changed after split up of the Multiprobe craft, 20 days and seven million miles before entry. If a cosmic ray particle impact changed command timing, causing a late start of experiment operations on one of the probes, some data high in the atmosphere would be lost on that probe before the back-up turn-on by an accelerometer. If operation of the probe started far too early, batteries would be exhausted and the probe lost. Because these timers have very small memories, probability of a late probe turn-on is about one in 700. Chance of a catastrophic early turn-on is less than one in 1200.

No serious effects of changes in stored commands have been identified for the Multiprobe's fifth entry craft, the transporter Bus.

Analyses have shown that for the Orbiter, the only catastrophic hazard would be mis-timed firing of the orbit insertion motor. This must be commanded by the Orbiter command memory because orbit insertion occurs when the spacecraft is behind the planet. Probabilities of a mis-timed firing, even if a "bit-flip" occurs during the crucial behind-the-planet period, are extremely low. This is because controllers will break down the required time delay before firing into a series of short time periods, so that loss of one period by a wrong command would only change firing time slightly. As a further protection, firing sequences will be loaded into both of the Orbiter's duplicate command memories. If one memory jumps ahead, it can be turned off and the other used; if one memory's time delay is increased, the other memory will maintain the schedule. The probability of a "bit-flip" in both memories over a few hours is extremely low.

The Pioneer Venus flights are the first designed primarily to study the atmosphere and weather of another planet.

Information gathered at Venus may help us learn more about the forces that drive the weather on our own planet.

- end -

October 30, 1978

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Peter Waller 415/965-5091

Release No. 78-51

For Release:
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TO TV AND PHOTO EDITORS:

OPPORTUNITY TO PHOTOGRAPH PMOC

On December 4, 1978, the Pioneer Venus Orbiter will enter orbit around Venus for a year or more. Five days later, on Dec. 9, the five atmosphere entry craft of the Pioneer Venus Multiprobe will enter the Venusian atmosphere. Twenty days earlier on Nov. 19, seven million miles from the planet, the Multiprobe will have split into its five component craft, sending them to entry points spread 6000 miles apart over Venus' Earth-facing hemisphere, a critical maneuver.

These Pioneer missions include the first U. S. orbiter of Venus, and the first U. S. operations in a really difficult atmosphere. (At the surface, Venus' atmosphere is 900°F, hotter than the melting point of zinc. Atmospheric pressure is 100 times Earth's--like being under 3300 feet of water.)

These missions will map Venus' unexplored hemisphere, and return data on its interior. They are the first devoted primarily to a planetary atmosphere. They should improve understanding of Venus' "simple weather machine," and this may help us understand the Earth's weather cycles.

The Russians also have two spacecraft en route to Venus, which may affect news coverage.

The missions are being controlled from the Pioneer Mission Operations Center (the PMOC) at NASA-Ames. Because of the critical operations underway there, visits to this facility will not be possible after Nov. 7, 1978.

On Tuesday, Nov. 7, all day, news photographers and cameramen are invited to cover PMOC operations. Mission controllers will be at work running four spacecraft. Ames will provide supplementary lighting, if needed, and any other assistance.

News photographers planning to visit the PMOC on that day should call (415) 965-5091 to make arrangements.

November 1, 1978

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75th ANNIVERSARY OF POWERED FLIGHT * 1903-1978 *

Stanley A. Miller 415/965-5091

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Release No. 78-53

YOUNG NAMED DEPUTY DIRECTOR, NASA AMES RESEARCH CENTER

A. Thomas Young, presently Director of the Planetary Program in NASA's Office of Space Science, has been named Deputy Director of NASA's Ames Research Center, Moffett Field, California. The assignment, effective February 1, 1979, was announced November 6, 1978, by Ames Director, C. A. Syvertson.

The NASA Ames Research Center is a major aeronautical laboratory for the United States with a modern complex of computers, wind tunnels, and ground-based and in-flight simulation facilities. These facilities are used in research and technology development for advanced aircraft with emphasis on STOL/VTOL aircraft and helicopters.

Ames also carries out an extensive research program in the life sciences, aimed at understanding the origin of life on Earth and searching for life elsewhere in the universe, understanding the effects of space and aeronautical flight upon humans and other life forms, and providing environments and equipment in spacecraft and aircraft that will permit crews and passengers to fly safely and perform effectively.

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In addition, Ames manages the Pioneer series of interplanetary spacecraft which successfully returned the first closeup pictures of the Planet Jupiter in 1973 and 1974. In December, the Pioneer Venus Orbiter and Multiprobe spacecraft will arrive at that planet to begin a study of the Venusian weather system, and in September, 1979, the Pioneer 11 spacecraft is scheduled to fly by Saturn, returning first pictures of that planet.

Mr. Young was appointed to his current position in November, 1976. Previously he served as Mission Operations Manager and Mission Director of Project Viking, a responsibility of NASA's Langley Research Center, Hampton, Virginia. Viking is a NASA flight effort directed toward exploration of the planet Mars using automated spacecraft. The Viking mission utilized the 1975/76 Mars opportunity to conduct scientific investigations from orbit, during entry, and on the surface. It was the first United States Mars mission to land science instruments on the surface of the planet.

Young joined the Langley Center in December, 1961, working on Project Vector until March, 1965, when he was named Mission Definition Manager of the Lunar Orbiter project. In 1968, Young was assigned the responsibility for the development of Mars mission objectives for the Advanced Space Project Office (Unmanned). Young was the Viking Science Integration Manager prior to his appointment as Viking Mission Operations Manager in early 1974.

Young received Langley Research Center's Sustained Superior Performance Awards in 1967 for his contributions to the Lunar Orbiter Project and in 1977 for his work on Viking. In 1977 he received NASA's highest award, the Distinguished Service Medal, for his contributions to Viking.

Young was born in Nassawadox, Virginia, April 19, 1938. He earned the degree of Bachelor of Aeronautical Engineering and Bachelor of Mechanical Engineering from the University of Virginia in 1961. Young was a Sloan Fellow at MIT in 1971-72 and received a Master of Management Degree.

Mr. and Mrs. Young and their son and daughter live near Annapolis, Maryland.

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75th ANNIVERSARY OF POWERED FLIGHT * 1903-1978 *

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IMMEDIATE

Release No. 78-56

PIONEER VENUS MULTIPROBE

TO SPLIT INTO FIVE SPACECRAFT

The Pioneer Venus Multiprobe spacecraft will split into five independent spacecraft in two of the most crucial operations of the entire Venus mission on Nov. 15 and 19.

The first such venture of this nature yet attempted in space, the maneuvers will separate the Multiprobe into five spacecraft, each with its own communication, power and instrument systems. The operation will take place 20 days seven-million miles from Venus.

The most critical maneuver will be performed on Nov. 19, when controllers release the three 200-pound North, Day and Night probes from the transporter Bus. Multiprobe then will be 20 million miles from Earth, traveling 21,000 miles per hour. The three probes must be released simultaneously at a time precise to few thousandths-of-a-second or they will not reach their designated entry points spread 6,000 miles apart over Venus' Earth-facing hemisphere.

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Entry points for the four probes and Bus, if projected onto a map of the Earth, would correspond roughly to Oslo, Norway (North Probe), the Malagasy Republic in the Indian Ocean (Night Probe), the mouth of the Amazon River in Brazil (Sounder Probe), Uruguay (Day Probe) and a point off the coast of Chili near Santiago (Bus).

The larger, 700-pound spacecraft, the Sounder Probe, will be released on Nov. 15. On that day, controllers first will reorient the cylindrical Bus so that its spin axis is aligned with the planned probe-entry trajectory. The Sounder Probe is centered on the Bus' spin axis.

The Sounder Probe then will be launched from the Bus at about 1:00 p.m. PST by the release of a pyrotechnic spring mechanism. When the mechanism is released, compressed springs on the Multiprobe will expand, pushing the Sounder Probe off the Bus toward its entry point at the equator on Venus' day side.

On Nov. 16, controllers again will change the Bus flight path, after tipping the Bus so that North, Day and Night probes are targeted for their points of atmosphere entry on Venus. They then will spin-up the Bus rotation to 48 rpm.

The North Probe will enter on the night side of Venus at high northern latitudes (60^{o}), in order to descend into the planet's north polar vortex. The Day Probe enters on the day side at mid-southern latitudes and the Night Probe on the night side at mid-southern latitudes.

These points will be reached only if North, Day and Night probes spin off simultaneously from three precise points in the circle of Bus rotation. This time of release for all three probes is programmed into the Bus command memory the day before the launch of the probes.

This split-second precision of separation to a few thousandths-of-a-second is a achieved by calculations of millisecond time delays for travel of the electrical impulse sent by the spacecraft command logic, times for firing of pyrotechnic actuators and for release of clamps holding the probes.

On the day of separation, Nov. 19, controller first will reverify the command sequence loaded the day before to be sure nothing has been altered in the precisely timed release sequence. They will reverify Bus tip to the desired release direction for North, Day, and Night probes.

On Nov. 19, Ames controllers will send the command from the Deep Space Network station, Canberra, Australia, which will release the probes. The command will go out at about 6:00 p.m. PST. The centrifugal force of the Bus spin will throw the probes tangentially from the Bus into their entry trajectories. After separation, the Day, Night, and North probes continue to spin at 48 rpm.

Within about four-and-a-half minutes after the probes are launched, controllers will know from readings of Bus telemetry whether or not the launch was successful. If the Bus reacts as expected, controllers will know that the probes are on course for their entry into Venus' atmosphere.

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When all four probes have separated, five spacecraft (including the Bus) with individual instruments and command-data systems will be headed for Venus' atmosphere.

During the 20 days from probe-split to atmosphere entry, the four probes will be dormant to save battery power. Controllers will not receive communication from them until 22 minutes before the craft enter Venus' atmosphere on Dec. 9.

Thus, when the first radio communication with the craft is due on Dec. 9, controllers will be tensely waiting to be sure all five craft will enter the atmosphere at the times and places required.

The Transporter Bus will follow the probes into the atmosphere on Dec. 9, taking the mission's only upper atmosphere composition measurements between 200-115 km (120-70 mi) and then burning up as it enters Venus' lower atmosphere.

The five atmosphere-entry craft will make direct measurements and observations within Venus' atmosphere, from top to bottom. These should provide by far the most detailed information yet gained on atmosphere composition, circulation, and energy balance.

Sounder Probe carries seven experiments, and the North, Day, and Night Probes three each. The Atmosphere Structure experiment on all four probes measures Venus' atmosphere, temperature and pressure, and determines its density. Sounder Probe's gas chromatograph and mass spectrometer should make the first detailed identifications of the chemical compounds and elements which make up Venus' atmosphere gases.

Entry of the probes into Venus' atmosphere marks the first U. S. operations in a really difficult atmosphere. All four probes are equipped with heat shields and titanium pressure vessels to help them withstand Venus' 480°C (900°F) heat, its corrosive atmosphere and its atmospheric pressure which is 100 times that of Earth. While the probes are not designed to survive impact, there is some possibility they will return data from Venus' surface.

Missions of the five Pioneer entry craft, and their companion spacecraft, the Orbiter, are the first devoted primarily to the atmosphere and weather of another planet. The six craft will conduct a total of 30 experiments which are expected to imcrove our understanding of Venus' simple weather machine. This should help us better understand the forces that drive Earth's weather.

The Orbiter spacecraft will be inserted into its Venus orbit on Dec. 4. It will send daily reports on the atmosphere of Venus, the Earth's closest neighboring planet, as well as pictures and surface maps.

The Pioneer project is managed by NASA-Ames Research Center. The spacecraft are built by Hughes Aircraft Company.

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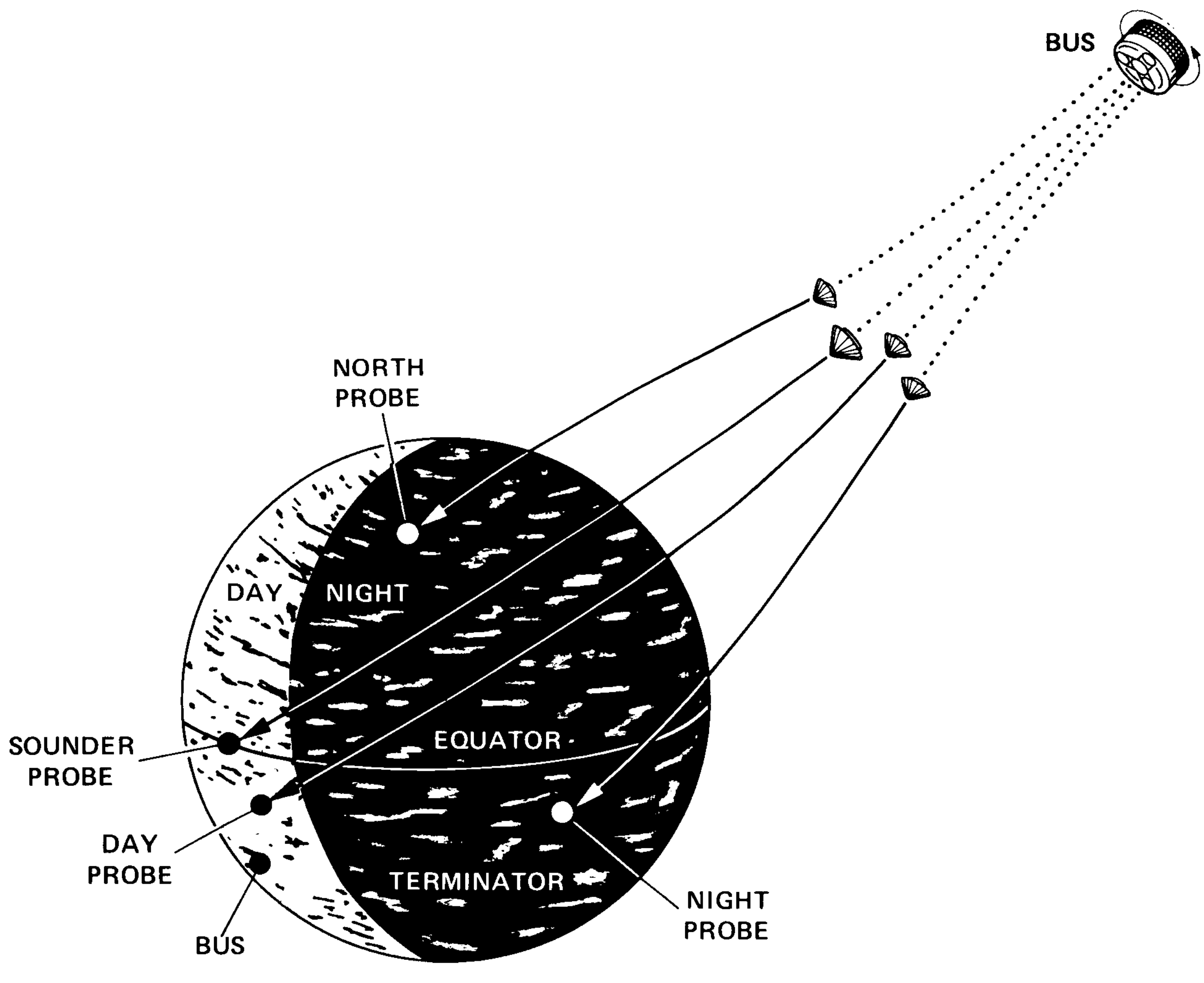
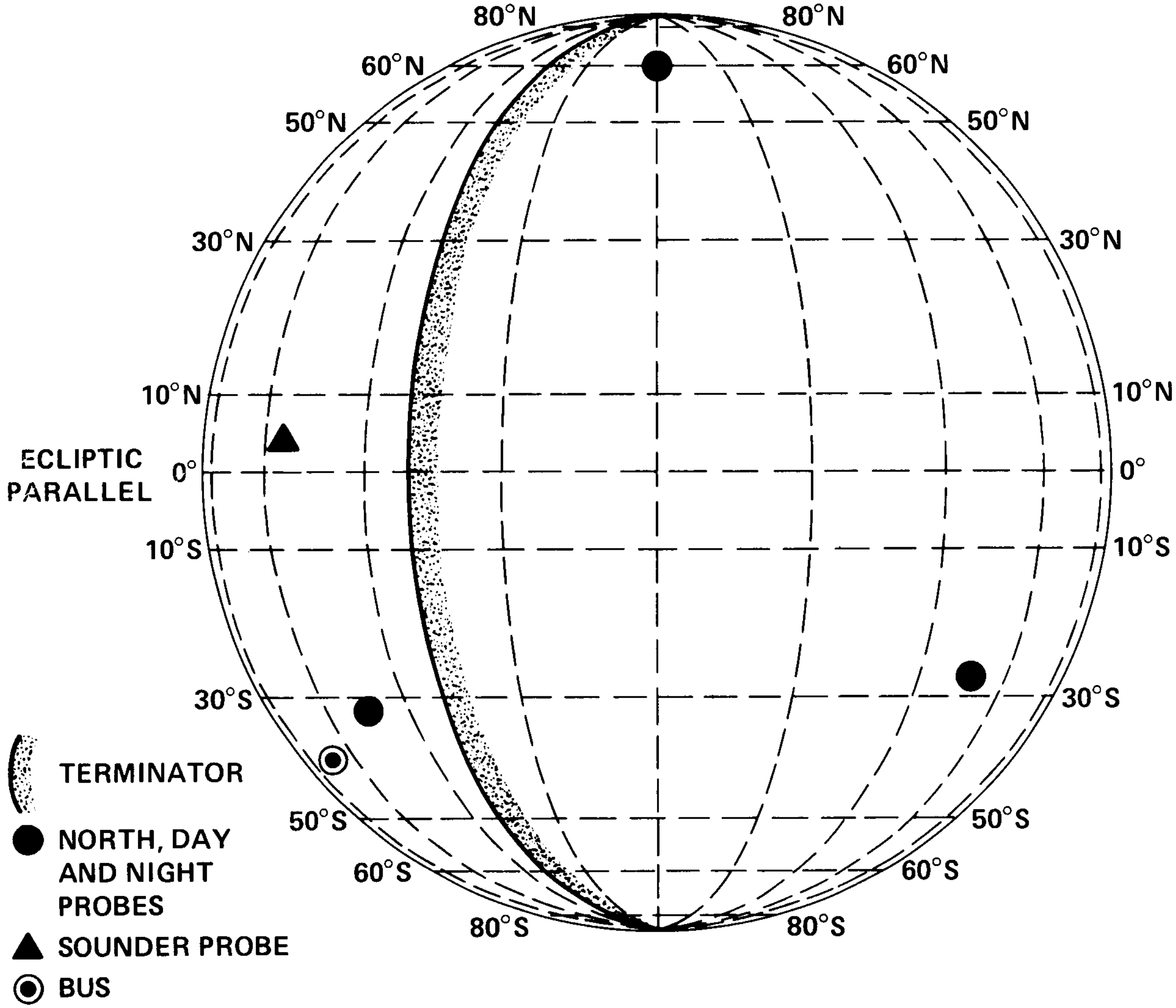
PIONEER VENUS ATMOSPHERE PROBES SEPARATION

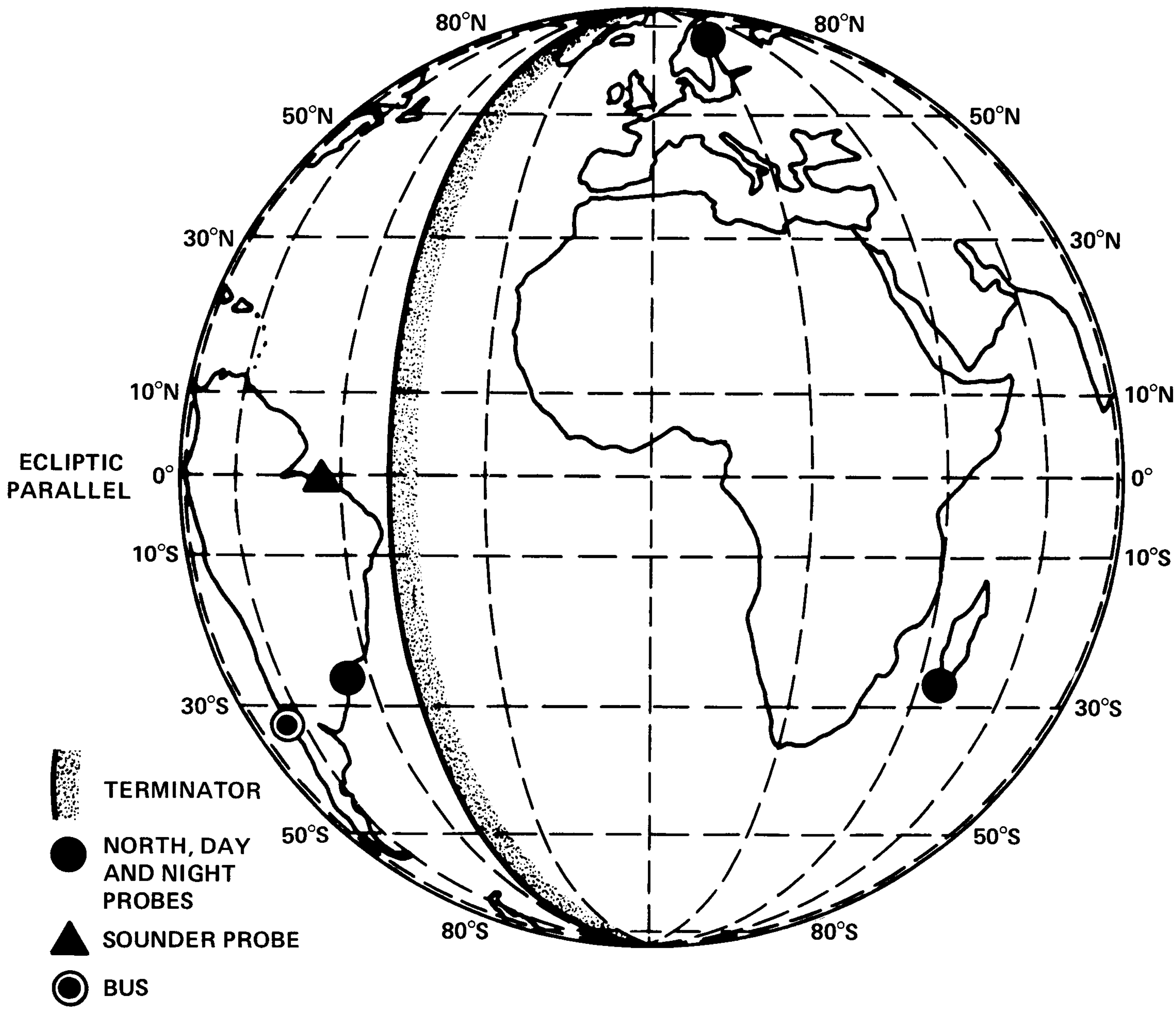


The transporter Bus releases the Sounder Probe 11.1 million km (6.9 million mi) from Venus on Nov. 15. Four days later, the Bus releases the three identical North, Day, and Night Probes, 9.3 million km (5.8 million mi) from Venus.

VIEW FROM EARTH OF MULTIPROBE ENTRY LOCATIONS



PIONEER VENUS ENTRY SITES SHOWN ON EARTH



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National Aeronautics and
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PLANETARY METEOROLOGY FACT SHEET

All the planets with atmospheres have common characteristics which are helpful in understanding weather and climate on Earth.

Return of the first data about Mars, Venus, and Jupiter's atmospheres has begun a major enlargement in the scope of the atmosphere sciences. Scientists now have examples from four planets instead of just one. Missions devoted primarily to planetary atmospheres, of which Pioneer Venus is the first, should greatly broaden this general atmosphere knowledge.

Scientists emphasize that in studying Earth the first place to look is at the Earth. However, useful insights into the behavior of the Earth's atmosphere can come from general planetary meteorology, and data from other planets provides an additional, valuable research tool.

Specific similarities to Earth's atmosphere exist on the other planets. These include Earth-like cold fronts on Mars and Earth-like high cloud layers on Venus. But scientists think the most significant findings from extraterrestrial atmospheres may lie in an improved general understanding of atmospheric circulation and climate. Such results may well

December 4, 1978

be more important for understanding Earth's multi-year weather cycles than for shorter term forcasting. Since various of man's activities currently appear to have potential for altering weather cycles, such understanding is important.

The Earth has had important climate changes in time periods meaningful to man, over decades and hundreds of years. Some examples with major economic consequences are the droughts in the American West every 22 years; recent destruction of the Sahel and expansion of the Sahara desert in Africa; effects of the Little Ice Age from 1450 to 1915 on agriculture in the Northern Hemisphere.

Mars, Venus, and Jupiter

For the terrestrial planets (Earth, Mars, and Venus), the main determinants of climate are: 1) changes in the Sun's output, 2) changes in orbits and axial tilts, 3) gas and dust content of the atmospheres, 4) land surface characteristics, 5) reservoirs of volatiles, and 6) outgassing of material from planet interiors. For nonterrestrial planets, Jupiter and Saturn, it is necessary to add an internal heat source.

Of the two other terrestrial planets, Mars seems to display the most Earth-like characteristics. It has the same length day. Its axial tilt is similar, giving it similar seasons. It appears to have circulation patterns like the Earth's cyclones. However, these seem to occur only in the winter hemisphere. In much of the summer hemisphere, the Earth-like prevailing westerlies turn into easterlies.

The big differences in Mars weather are thought to be the major role of the planet's carbon dioxide atmosphere--and the role of heat-absorbing dust.

The condensation of Mars' carbon dioxide atmosphere into ice at the pole of the winter hemisphere means that there is a steady flow of the 95 percent carbon dioxide atmosphere to the winter pole, where it freezes. The polar region constantly and evenly sucks in new atmosphere to replace that frozen out.

This continuous flow, and permanent low pressure zone at the winter pole, apparently has planet-wide effects in both winter and summer hemispheres because it alters the atmospheric pressure and affects large-scale winds. The poleward flow direction reverses twice each Martian year, with Martian winter and summer.

Dust on Mars seems to have some of the heat-transferring characteristics of water vapor on Earth. The feedback mechanism of the Martian Great Dust Storms may control climate on a global scale and shows some parallels to the water cycle on the Earth. The "tidal" flow of the thin Martian atmosphere appears to be due to big, local solar heating effects resulting from heat absorption by dust. (Temperatures rise 10-20° C in a few hours.) The atmosphere expands rapidly from the heated local noon point, creating 20 mph winds. As the local noon point moves rapidly over the Martian surface, these winds ebb and flow like sea and land breezes. In Mars' mid-latitudes, the winds also are channeled by Mars' high mountain ridges, producing strong boundary flows. In the equatorial regions, sun-warmed mountains provide "heat islands" in the atmosphere. These tidal winds, the mountain-range channeling, and the elevated heat sources in the atmosphere provided by mountains also exist on Earth, but the best examples are on Mars.

Venus, on the other hand has atmosphere motions and characteristics far different from those of Earth. Its atmosphere is 100 times as massive as Earth's and temperature at the surface is 900°F. Sluggish winds in the almost liquid atmosphere at the surface are 1-2 mph, while at the clouds tops, around 60 km altitude, the winds blow at 200 mph. Venus' climate is believed to be the result of a "runaway greenhouse effect" in which solar heat is trapped easily--but only reradiated with great difficulty.

For purposes of comparative meteorology, Venus appears to be valuable because it seems to be a simple weather machine. Its major atmosphere motions appear to be global. Heat distribution over the planet appears to be almost completely uniform at all points. This means that the many observations of the six spacecraft of Pioneer Venus may well be able to provide a good characteriszation of Venus' atmosphere circulation, composition, and structure in one combined operation.

Atmosphere scientists have great interest in a radically different planet like Venus because they view the other planets as weather laboratories. The mathematical models describing behavior of the Earth's atmosphere frequently fail to account for all the atmosphere motions. So scientists want, where feasible, to test out the same kinds of relationships under extreme conditions--with different gases and under very different temperatures and pressures. As one researcher puts it, "If a theory seems to work on two or three planets, it's probably right."

A completely gaseous, giant planet, Jupiter, also can help. Jupiter's atmosphere, driven by internal heat, flows round-and-round the planet, showing the same general patterns for years at a time. This is due to the giant planet's rapid rotation, and the long relaxation times of its atmosphere gases. Jupiter's many hurricane-like features appear to be similar to Earth hurricanes, and like those on Earth, to be driven by the heat of water vapor condensation. However, since no direct atmosphere measurements have been made and the amount of water vapor is unknown this will have to remain conjecture until the Galileo mission sends a probe into the atmosphere. Close-up Pioneer Jupiter photos of Jupiter's clouds show other circulation patterns that appear to be Earth-like.

Earth's Weather Cycles

In addition to several already mentioned, the Earth has had various other climatic changes which are a result of planetary weather cycles. These have been, and will be again, of great importance to man. The most recent ice age ended long ago, about 12,000 years ago. But this means that the current warm, ice-free period has already lasted about as long as the typical lengths of interglacial periods in the last million years. The onset of past ice ages has been known in at least one instance to take as little as 100 years, though onset is usually gradual.

Ice ages, obviously, are due to climatic cooling, and a decline of as little as $1^{\circ}C$ in the average global temperature would affect northern region agriculture. It has been suggested that a one-degree temperature drop might endanger the Canadian wheat crop.

The most recent major temperature decline occurred during the Little Ice Age, 1450 to 1915. In England during this cold epoch, the Thames River froze over so thickly that fires were built on the ice to roast oxen for ice fairs. Today, the Thames almost never freezes. The Norse colony in Greenland, established centuries before, perished in this period because of pack ice in the North Atlantic and the disappearance of most agriculture there due to cold.

The best evidence suggests that the Little Ice Age was due to an almost continuous series of huge volcanic eruptions in those years (Tambora, 1815; Krakatoa, 1883; Pele, 1902 etc.), combined with some other factor, perhaps a short-term variation in solar heat output. These volcanic eruptions injected volcanic gases into the stratosphere, which turned into heat-reflecting sulfuric acid droplets, blocking solar heating.

Interestingly, these sulphuric acid droplets, scientists believe, are identical to droplets in the clouds of Venus. These droplets have major effects on Venus' climate. We need to consider that industrial pollution produces acid droplets like the Venusian and volcano-injected droplets, and a build-up in the lower atmosphere could cause important, though probably less dramatic climate change.

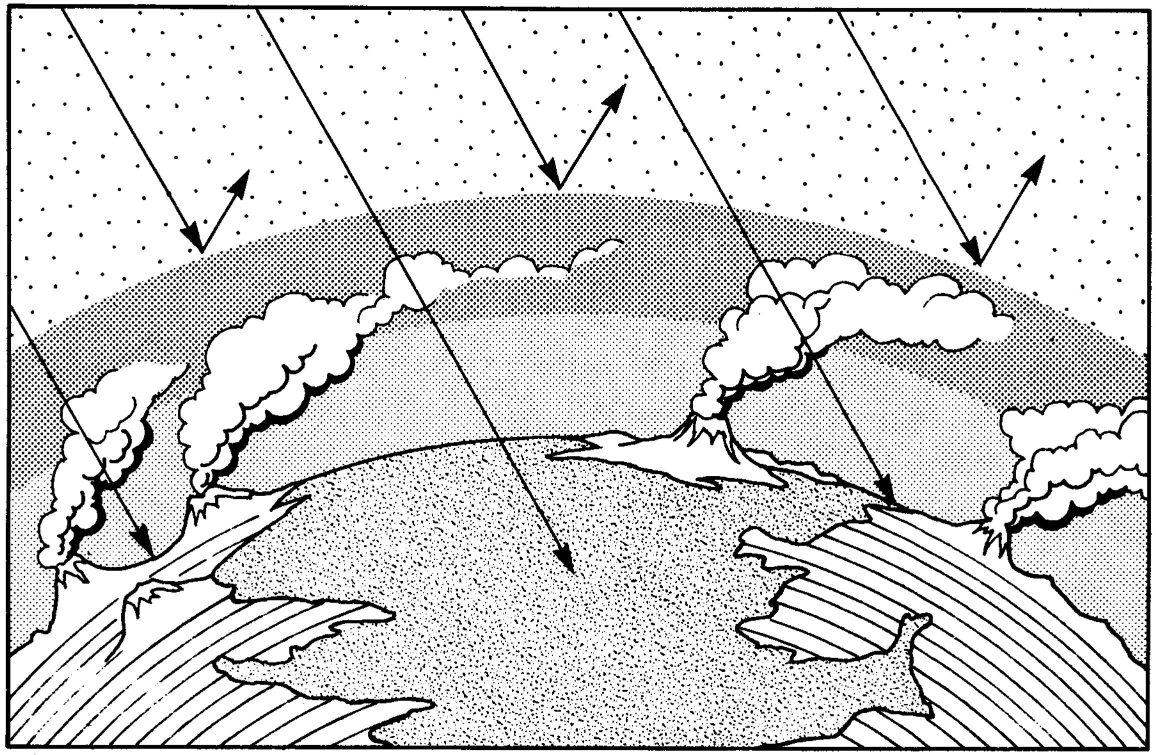
The Little Ice Age was followed by a period of warming in the northern hemisphere for 55 years (a $1.1^{\circ}C$ increase in average temperature) and then a 20-year period of cooling in the 1950s and 60s, $.6^{\circ}C$, which shortened by two weeks the English growing season.

Cooling also affects rainfall. During the colder portion of the last 100 years in Northwest India, there were more years having abnormally low rainfall than in the warmer years. Some researchers suggest that dust from mechanized agriculture, like that generated in the dust storms of the 1930s may also have produced relatively local atmosphere cooling.

It has been suggested that the flood widely reported in the Bible and other early writings was due to the abrupt ending of the last ice age 10,000 years ago, with a consequent rapid rise in sea level. At its maximum, the last ice age--the Wisconsin--lowered sea level 100 meters. Today, even after the ocean rise to "normal", there is enough ice locked in Antarctica and Greenland to raise the oceans another 100 meters from present levels.

Venusian phenomena can be related to these Earthly ice/water ratios. Venus' hell-like climate and atmosphere is believed due to a runaway greenhouse effect, where large amounts of solar heat are retained, and only reradiated with difficulty.

LITTLE ICE AGE
1450-1615



The "Little Ice Age" on Earth saw a dramatic cooling of the Earth's climate. England's Thames River froze over, European villages were overrun by glaciers and no ships could reach Greenland, which had been colonized centuries before. Many scientists believe the large number of volcanic eruptions in this period were largely responsible for the planet-wide cooling. Volcanoes spew into the atmosphere great quantities of dust which turn into tiny sulfuric acid particles. These reflect sunlight away from the Earth's surface, causing it to cool. The pale yellowish clouds which obscure the surface of Venus are thought to consist of virtually identical sulfuric acid droplets. Studying Venus' clouds may help us better understand the role these droplets play in Earth's weather.

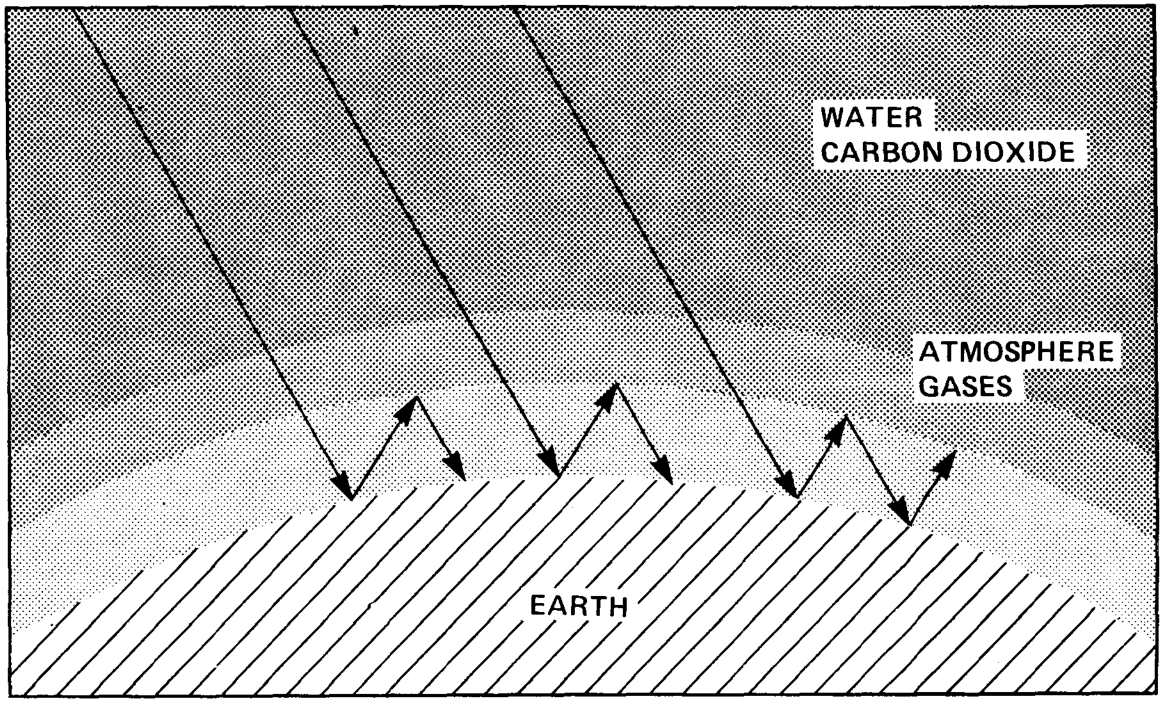
The Venusian greenhouse is believed due to trapping of heat by atmospheric carbon dioxide, and if Venus ever had any water, by atmospheric water vapor as well. (Today the sulfuric acid clouds, believed to have appeared later in the evolution of the atmosphere, add a kind of lid to further hold the heat in, superheating the Venusian air.)

At present rates of increase in the burning of fossil fuels, we are adding to the Earth's atmospheric carbon dioxide at a rapid rate, with several researchers predicting a doubling in the amount by the year 2050. This might well increase the Earth's greenhouse effect, and hence its average temperature. This would probably be a relatively minor effect (about $1^{\circ}C$ increase in average global temperature). But it might be enough to melt portions of the Antarctic and Greenland ice caps--enough perhaps to cause major, permanent flooding of coastal cities.

Atmospheric dust may have an important, though probably secondary role on Earth. On Mars, atmospheric dust seems to be a prime mover. The Great Dust Storms on Mars, during which the whole planet is obscured by dust, radically change the planet's atmospheric temperature structure because the atmospheric dust absorbs solar heat directly.

Mars' atmosphere always seems to have much more suspended dust than the Earth's--on the average about ten times as much as the amount above a large city on a smoggy day.

GREENHOUSE EFFECT TRAPS SOLAR ENERGY



The "runaway greenhouse" theory argues that Venus' atmosphere allows some sunlight to reach the planet's surface but stops most of the outgoing heat radiation. The thick cloud layers and carbon dioxide atmosphere block surface heat from radiating back into space, creating 485 degree C (900 degree F) surface temperatures. Some scientists warn that as we burn vast amounts of fossil fuels we increase CO2 levels in the Earth's atmosphere, and may be creating a runaway greenhouse like that on Venus.

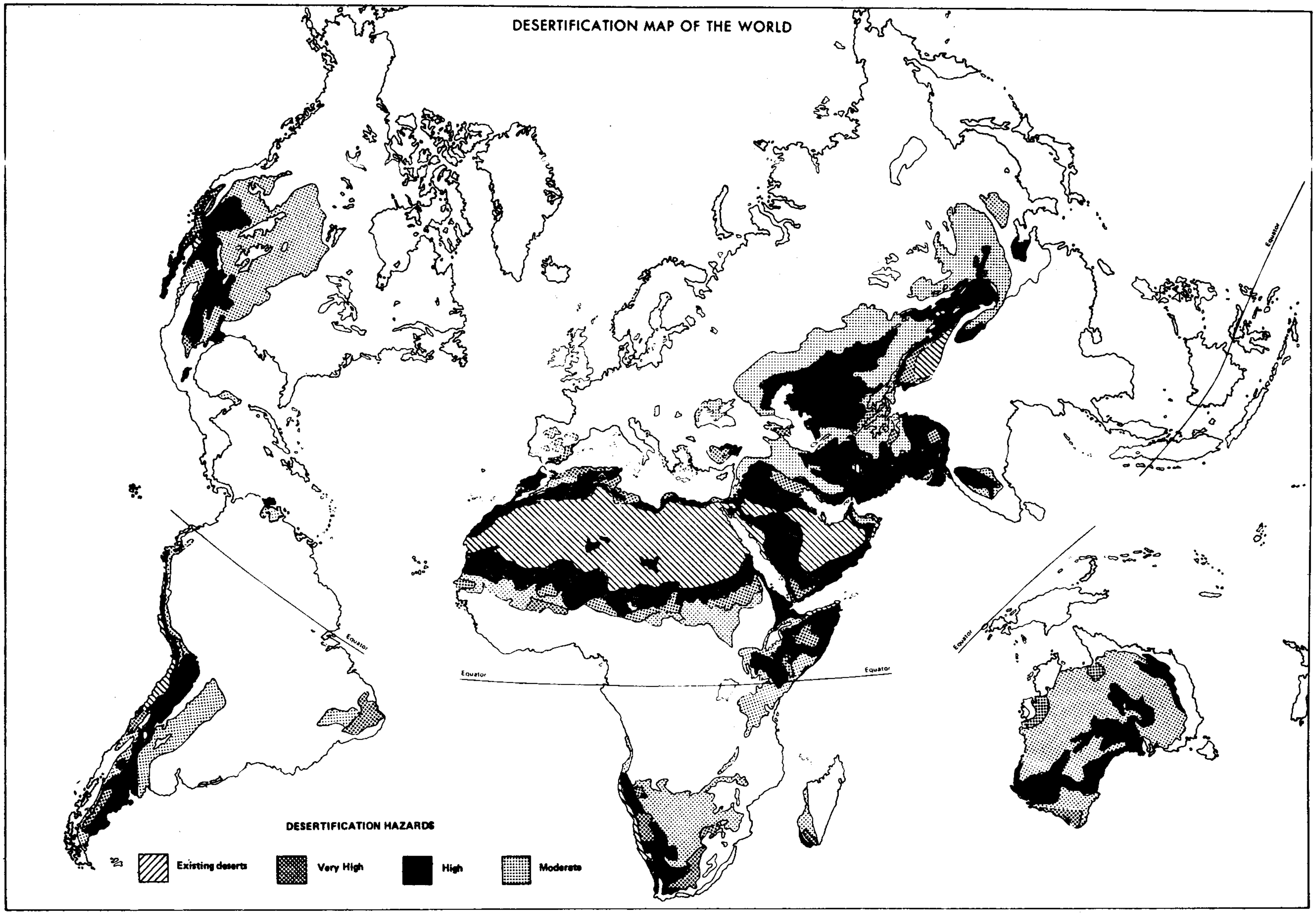
Heat absorption by dust can raise atmosphere temperature on Mars as much as 25°C in one day. This generates winds, and as more dust is pumped up into the atmosphere, more heating occurs, until the whole planet is veiled in dust. This process may be in some ways analogous to the energy build up in tropical hurricanes, but the water vapor in Earth's atmosphere disappears as it rains out, keeping hurricanes local. Martian dust and its effects may stay aloft planet-wide for months.

Other effects also related to surface conditions seem to have occurred on Earth in the Sahel region of Africa. There overgrazing reduced planet cover and made the surface more reflective of solar heat, thus cooling it. This cooling reduced upward motion of the atmosphere and the amount of rain. The resulting drought further reduced plant cover and made the drought even more serious.

Planetary Weather Laboratories

Further examples of the planets as weather laboratories where the same phenomenon can be studied in different locations, are these:

1) There is substantial evidence for correlations of 11 and 22-year cycles of solar storm activity with Earth's weather cycles. For several hundred years, there have been droughts somewhere in American West every 22 years. These correlations to solar storms also appear to operate over much shorter periods. They may be due to a triggering mechanism, it has been suggested by a number of scientists. Recently, Dr. Ralph Markson of MIT, and other groups at UC, Berkeley, Johns Hopkins and elsewhere, reported


DESERTIFICATION MAP OF THE WORLD
Equator
Equator
Equator
Equator
DESERTIFICATION HAZARDS
Existing deserts
Very High
High
Moderate

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the findings of a relationship between these weather cycles and incoming high energy solar and cosmic ray particles. The atmosphere can be thought of as an electric generator, and these particles now seem to be able to alter atmosphere conductivity and change thunderstorm patterns. Thunderstorms are major distributors of energy in the atmosphere. There are 1500 of them, on the average, raging somewhere in the world at any given time. Understanding the effects of solar storms on Venus, Mars, and Jupiter's atmospheres may help with understanding these relationships on Earth.

2) The Venus weather machine is believed a simple one because the planet has no axial tilt; hence no seasons. It has almost no rotation and hence lacks short day-night cycles, as well as the coriolis forces which rotate Earth cyclones. It lacks the oceans which store and transport much of the Earth's heat. Its cloud cover is planet-wide, eliminating the effects of cloud and clear areas. The mountainous relief of its surface areas mapped so far appears to be lower than Earth's and much lower than the dramatic Martian uplands and mountains.

Like Earth's, Venus' climate is believed to have evolved and changed radically. Venus is in several ways identical to Earth, and is often called our twin planet. Calculations suggest that if Earth were only six million miles closer to the Sun, it, like Venus, would have had a runaway greenhouse effect. With this terrific heating, Earth's atmosphere would now be as massive as Venus', 100 times as dense as it now is--like being under 3300 feet of water. Such heating would boil out all the carbon and oxygen from the Earth's calcium carbonate rocks, vaporize the water of the oceans and most other volatiles.

If Venus had no greenhouse effect, the planet, which is 26 million miles closer to the Sun than Earth, would be hotter than Earth. (About twice as much solar heat arrives at Venus as at Earth). But its polar regions would have habitable temperatures. Scientists believe that Venus' greater solar heating progressively forced the planet's volatiles into the atmosphere and the intensifying greenhouse effect made it hotter and hotter. The sulfuric acid clouds further intersified the greenhouse effect, adding still more heat to the Venusian pressure cooker.

3) Earth-like Mars with its 24-hour rotation and day-night cycles, a relatively clear atmosphere, and tilt on its axis (seasons), also shows climate change. There is evidence of running water (the numerous dried up river beds of today's Martian landscapes). The liquid water which flowed on Mars in the past is thought to have been due to:

1. Outgassing of the planet from volcanos, which produced a thicker atmosphere. Like Earth's before life appeared, this atmosphere probably contained substantial hydrogen compounds (a reducing atmosphere).

2. A thicker reducing atmosphere would have had a higher vapor pressure, preventing atmosphere freeze-out at the poles and allowing water to remain liquid instead of vaporizing immmediately. It also would have created a greenhouse effect, allowing water to remain liquid instead of freezing. Ironically, since then, the presence of water may have greatly thinned out the atmosphere by aiding the lock-up of much atmosphere gas in carbonate rocks. The deep layer of Martian dust probably holds still more gas adsorbed to the huge surface area of trillions of dust particles.

Other Examples

Among many other examples of similarities of planetary atmospheres are the following:

- Both Mars and Venus provide models of how planets transport their atmosphere constituents vertically. Vertical transport on Earth is an important part of understanding how trace gases such as fluorocarbons might affect our ozone layer and weather. Interest in this began as a result of findings about the effect of chlorine compounds on stratospheric ozone. These findings were derived from Venus studies, and have led to government regulation of a billion dollar industry.

- Atmospheric wave motions may be the key to understanding all weather and climate. The Earth's temperate zones' cyclones and anti-cyclones are horizontal waves. Venus' sluggish surface winds are believed to transfer their huge momentum to the thin upper atmosphere, producing 200 mph winds, by cascading wave motions. Large temperature and velocity waves on Mars appear to be an everyday feature. Venus, Mars, and Jupiter exhibit a variety of other wave motions. (Jupiter's Great Red Spot may be a standing wave.) Waves appear to determine the weather patterns on Mars, Venus, Jupiter and Earth. This variety of waves makes the general study of wave motions easier.

• The drivers for Venus' atmosphere circulation appear to be an equator-to-pole Hadley cell (a single continuous circulation pattern for each hemisphere). The Earth's equatorial circulation (the easterly winds of the Northeast Trades result from a Hadley cell, and the Martian summer hemisphere easterlies appear to be of this type.

• Basic differences between the terrestrial planets are shown by temperature differences between their equators where the most solar heat is absorbed, and the poles where almost no heat is absorbed. For Venus, the difference is 2%; for Earth, 15%; and for Mars 40%. If a planet distributes its heat evenly (like Venus), its atmosphere is, by definition, efficient in transporting heat to the cold poles, instead of radiating it back to space. This efficiency correlates almost exactly with the atmosphere's pressure and density. Venus' thick atmosphere circulates most of the heat planet-wide. Mars thin atmosphere loses almost half of it.

PLANETARY COMPARISONS

PLANET	SURFACE PRESSURE IN EARTH ATMOSPHERES	AVERAGE SURFACE TEMP. IN °F	ATMOSPHERIC CONSTITUENTS Major	ATMOSPHERIC CONSTITUENTS Minor
VENUS	90	900°	CO_2	HCl, HF CO, H_2O
EARTH	1	80°	N_2, O_2 A	CO_2, H_2O O_3, etc.
MARS	.006	-45°	CO_2	O_2, H_2O CO

PLANET	CLOUD COVER	SURFACE CONDITIONS	DIRECTION CHANGE IN POLEWARD FLOW DUE TO CORIOLIS (AT 30° LATITUDE)	% OF ATMOSPHERE BELOW HIGH TOPOGRAPHY	LENGTH OF DAY
VENUS	100%	Chemical: Equilibrium	3°/day	20%	117.6 Earth days
EARTH	50%	Liquid	14.4°/hr	30%	24 hrs.
MARS	5%	Dusty	14.4°/hr	60%	24.6 hrs.

PLANET	TIME FOR ATMOSPHERE TO RETURN TO FORMER STATE AFTER LOCAL HEAT INPUT: BY RADIATION	BY ATMOSPHERE CIRCULATION	TEMPERATURE DECREASE FROM SURFACE °F/MILE
VENUS	31.7 years	8.3 hrs.	34° F
EARTH	116 days	50 min.	23° F
MARS	2.3 days	83 min.	5° F

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January 29,1979

Release No. 79-02

Note to Editors:

VENUS RESULTS BRIEFING

Significant new findings of the six Pioneer spacecraft at Venus will be discussed in a press briefing at 10 a.m., Wednesday, February 7, at NASA's Ames Research Center, Mountain View, CA.

Most of the 30 Pioneer Venus principal investigators now have reduced their data--since entry of the five probes into Venus' dense, searing atmosphere, last December 9. The Venus Orbiter has continued to circle the planet since arrival there on December 4, 1978. It has returned a variety of measurements and pictures.

The atmosphere probes are the first U.S. vehicles to enter Venus' difficult atmosphere. The Orbiter is the first prolonged orbiter of the planet.

Scientists will present new data or composition and dynamics of Venus' atmosphere, as well as, information on the planet's surface. For television and photo editors, full disc photos of the planet and significant ultraviolet and infrared views of Venus will be available, along with other visuals.

News people attending should come to the NASA gate of Moffett Field, and will be directed from there.

NASA News

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EARLY FINDINGS FROM PIONEER VENUS

Early scientific findings by Pioneer Venus 1 and 2 include new information on the formation of the inner planets, an explanation for the heat which creates Venus' hell-like atmosphere and surface, and observation of "mysterious chemical fires" on the planet's surface.

Pioneer Venus 1, an orbiter, and the five atmospheric probes which comprised Pioneer Venus 2, reached cloud-covered Venus on Dec. 5 and 9, 1978.

The instrument-laden probes descended through the Venusian atmosphere to the surface, while the orbiter began an eight-month orbit of the planet, making measurements and taking pictures.

Scientists think the findings from Pioneer Venus about the Venus weather machine may help us understand the forces that drive the weather on Earth.

- more -

February 8, 1979

Although much more analysis is needed, early Pioneer findings seem to provide new information about the formative years of the inner planets, Mercury, Venus, Earth, and Mars--and at what period the Sun ignited during these building processes.

Pioneer results also suggest that Venus' atmosphere circulates in large-scale global motions.

Other major findings include:

- The planet's searing atmosphere and surface heat now seem quite certainly to be due to a "runaway greenhouse effect."

- Venus' clouds come in three well-defined, distinct layers, and seem to result from a vigorous cycle of sulfur-hydrogen-oxygen reactions. Spacecraft instruments also found that the clouds are composed mostly of oxygen, water vapor and sulfur dioxide.

- Data from the orbiter's first radar map suggests that Venus' topography could be similar to Earth's, with high mountain-like features and extensive relatively flat areas. The Pioneer Day Probe also showed the presence of fine dust on the surface at its landing site in the southern hemisphere. This dust took about three minutes to settle after impact of the 90-kilogram (200-pound) probe at 35 kilometers per hour (22 miles per hour). The Day Probe survived for 67 minutes after landing.

- more -

- Starting at 13 km (8 mi.) altitude, the two night-side probes saw an unexpected glow increasing as the probes descended. Mass spectrometer evidence for various sulfur compounds near the surface suggests that the mysterious glow could come from "chemical fires" on the surface or in the very hot and dense lower atmosphere near the surface. The "fires" would be fueled by reactions involving the sulfur compounds. Experimenters are considering another possibility--that the glow resulted from the heated or electrically charged surfaces of the probe craft themselves.

- The solar wind interacts with the Venusian atmosphere several times more strongly than expected. Unlike solar wind interaction on Earth, three key upper atmosphere regions were discovered to almost coincide. They are the turbopause, where atmospheric mixing begins; the region of maximum ion density; and the base of the exosphere (the region where gases escape the planet to space).

- The Pioneer Venus spacecraft have thus far identified 10 chemical constituents of the atmosphere and 10 ions in the ionosphere of Venus.

- more -

● Composition of the planet's atmosphere appears to be as follows: about 97 per cent carbon dioxide, 1-3 per cent nitrogen, 250 parts per million (ppm) helium, 6-250 ppm neon, and 20-200 ppm argon. Other constituents measured below the cloud layer were water vapor 0.1 to 0.4 per cent, sulfur dioxide 240 ppm, and oxygen 60 ppm. There is indirect evidence that sulfuric acid and elemental sulfur particles also are found in the clouds. Further data analysis is expected to turn up additional sulfur compounds as well as other constituents.

Primordial Argon and Neon and Planet Formation

Pioneer found several hundred times more primordial argon and neon on Venus than on Earth. Mars, on the other hand, has far smaller amounts of these two primordial gases than has the Earth.

The argon/neon findings challenge most theories of Solar System formation, which propose that the Sun and planets formed at about the same time, with the planets forming from a gas cloud surrounding the Sun and composed of the same elements as the Sun.

- more -

The inner planets (Mercury, Venus, Earth, and Mars) are believed to be small and rocky because the Sun either swept away the light constituents (hydrogen, helium, argon, neon) by a more powerful solar wind than today's, or solar tidal effects may have pulled the light constituents into the young Sun. The other gas giants like Jupiter and Saturn appear to have kept their light gases. Jupiter, for example, is believed to consist of approxmately the same mix of materials as the Sun.

Prior to Pioneer Venus, the generally accepted theory was that the volatile elements present in the atmospheres of Mars, Earth, and Venus were originally trapped in the material that ultimately formed those planets, and that these elements were subsequently degassed from each planet's interior to form its atmosphere. It also was generally assumed that the original solar gas and dust cloud was hot in the center and much cooler farther out at the time when the rare gases and other volatile elements were being trapped in the pre-planetary material. If this were correct, the abundance of rare gases should be lower on planets closer to the center of the Solar System than on planets farther out. However, the Pioneer data showed that the observed abundance pattern is the opposite.

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These new results may mean that the temperature distribution in the early Solar System at the time the volatiles were trapped, was different than generally assumed.

If the entire gas cloud, which later formed the Sun and the planets, was evenly heated, then concentrations of light gases and other materials would increase going in toward the center due to gravity. These gases could then have been absorbed on dust grains in the gas cloud and the abundance of gases would be highest where the pressure was highest, that is in regions closer to the center of the nebula. In turn, as the dust consolidated into rock, the gases would have become trapped inside either large rocky masses which later formed the inner planets or inside the completely formed planets before the Sun heated up.

The fact that neon and argon are found in about the same proportions on Venus and Earth further strengthens the idea of a more uniform process and steady increase in density of all materials going toward the Sun.

While much more analysis is needed, these findings seem to begin to explain some of the mechanisms in the formation of the Solar System and planets.

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"Greenhouse" Heat Theory Strengthened

The intense Venus heat now seems to be explained by a massive "greenhouse" mechanism instead of by the competing theory of heat circulation from the top of the atmosphere down. In the greenhouse effect, solar radiation enters the atmosphere relatively easily but is reradiated to space as heat only with great difficulty. The trapped radiation heats up the planet and its atmosphere.

Of Venus' total incoming sunlight, about 75 per cent is reflected back to space by the Venus clouds and dense atmosphere. Of the remaining 25 per cent that penetrates Venus, about 60 per cent is absorbed in clouds, 15 per cent in the atmosphere above the clouds, 15 per cent in the lower atmosphere, and 10 per cent at the surface.

As this absorbed solar energy attempts to leave the surface and atmosphere as heat radiation, two materials, identified by Pioneer Venus, hold the heat in the atmosphere. Until now, the dense (97 per cent) carbon dioxide atmosphere was known to trap much of the heat, but not enough to account for the searing Venus surface temperatures, 455 degrees Celsius (850 degrees Fahrenheit).

The somewhat surprising finding is that 0.1 to 0.4 per cent water vapor content of the atmosphere provides the second very strong heat trap. Finally, it is now believed that the large solid and liquid sulfur particles in the cloud layers contribute to putting a lid on the Venusian pressure cooker, holding in still more heat.

Venus Cloud Profile

The Venus cloud layers have a total thickness of about 20 km (12 mi.). There are three distinct cloud layers.

The top layer of clouds is about 14 km (9 mi.) thick, from 70-56 km (43-35 mi.) altitude. This layer is made up of 1-2-micron diameter particles which seem to be sulfuric acid with about 300 particles per cubic centimeter. Temperature of this layer is around 13°C (55°F.).

The second cloud layer is 6 km (4 mi.) thick, from 56-49.5 km (35-31 mi.). This layer appears to be made up of the 1-2-micron sulfuric acid particles, 4-micron particles which appear to be some form of liquid, and 10-15-micron particles which could be solid elemental sulfur. This cloud layer has about 100 particles per cubic centimeter. Its temperature is about 20°C (68°F.).

The bottom layer is the only layer opaque enough to be like most Earth cloud structures. Two km (3 mi.) thick, the layer lies between 49.5-47.5 km (31-30 mi.) altitude. It is the densest of the three layers with 400 particles per cubic centimeter and has but a few 1-2-micron sulfuric acid particles and many large 10-15-micron particles of what might be both liquid and solid sulfur. Temperature in this bottom layer is about 202°C (395°F.).

Near the bottom of this dense sulfur cloud, at about 47.5 km (29 mi.)altitude, the temperature appears to be near the melting point of sulfur. A "pre-cloud" layer of droplets similar in composition to the top cloud layer--with 300 particles per cubic centimeter--appears at this level for a few hundred meters. A faint haze then appears below, made up of submicron particles which might be sulfuric acid. These tiny particles are present in densities of about 20 particles per cubic centimeter. They thin out to about two particles per cubic centimeter at the bottom of the haze layer, at about 30 km (19 mi.).

From about 30 km (19 mi.) down to the surface, the atmosphere is free of particles, according to the data.

Cloud Circulation Process

Sulfuric acid droplets plus liquid and solid sulfur appear to drift slowly down from the clouds, falling to the hotter, lower altitude, about 47.5 km (29 mi.). There this material vaporizes and splits up, forming a kind of "chemical stew." The basic building blocks of the Venus cloud particles--water vapor, sulfur dioxide and molecular oxygen--have so far been measured in this region.

In addition, a variety of sulfur compounds are beleived to be formed. This sulfurous "soup" then appears to be recirculated back up to the cloud layers where it is re-formed into sulfuric acid and sulfur, perhaps by reactions involving incoming solar ultraviolet radiation.

The presence of free oxygen and water vapor in Venus' lower atmosphere and its absence in significant amounts above the clouds suggest that the reactions in the clouds are so vigorous that they remove the free oxygen and water vapor and prevent them from passing through the clouds.

Elemental sulfur is not found above 56 km (35 mi.). This is high enough for ultraviolet light to penetrate through the thin upper clouds and be absorbed by sulfur. (Prominent dark cloud markings in ultraviolet pictures of Venus seem to be due to sulfur absorption.)

First Surface Mapping

The first preliminary scans by the orbiter's radar mapper showed that in a previously unexplored 1900-km (1200-mi.)-strip on Venus' surface much of the terrain appears relatively flat, similar to Earth's surface and dissimilar to the rough, cratered terrain of Mars and the Moon.

An exception to the relatively smooth surface on Venus was a drop in altitude of 10,000 feet over one area 120 km (75 mi.) long. This is comparable to the drop between the crest of the Front Range of the Rocky Mountains near Denver to a spot out in the Great Plains to the east. More scans by the orbiter will be needed for any kind of comprehensive picture of Venus' terrain.

Cloud Tops and Atmospheric Circulation

Detailed findings by the orbiter's infrared radiometer about Venus' upper atmosphere and cloud tops included the fact that the temperatures on the day side of Venus are very close to those on the night side. Nephelometer findings also show that cloud tops are close to the same heights on both day and night sides.

Other radiometer findings at the poles appear to confirm theories of a downward-moving polar vortex.

Surprisingly, the belt of atmosphere above the cloud tops at the poles is about 10°C (21°F.) hotter than at the equator. This contradicts earlier findings that the poles were 10°C (21°F.) cooler than the equator.

At about 70° latitude, a wide ring of colder and higher clouds circles the poles Temperature of these clouds is about -58°C (-73°F.) -- about 50°C colder than the hottest polar cloud top temperature. In the "polar hole" believed created by the vortex, cloud tops seem about 10 km (6 mi.) lower than surrounding cloud tops. Cloud temperature in the hole is about 30°C higher than average cloud top temperatures. Both the atmosphere and the clouds get warmer going down to the lower altitudes in the polar hole.

Finally, there appears to be a haze layer about 10 km (6 mi.) above the clouds, surrounding the planet but thicker over the polar regions. The polar haze appears to be opaque to the longer infrared wavelengths. The opaque material has characteristics similar to water vapor or ice crystals, as in Earth's cirrus clouds.

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Upper Atmosphere

In upper atmosphere findings, the sensible atmosphere of Venus begins at 250 km (155 mi.) altitude and has a density of 10^{-15} grams/cc. It reaches a density of 10^{-10} grams/cc at 125 km (78 mi.). The turbopause (where atmospheric-mixing replaces atmosphere layered by weight) begins at an altitude of 144 km (90 mi.). Temperature at 250 km (155 mi.) is 27°C (80°F.). At 100 km (62 mi.) it drops to -93°C (-136°F.) and near the surface rises again to 447°C (836°F.).

Above the turbopause, the Pioneer craft thus far have found hydrogen, oxygen, carbon dioxide, argon, helium, nitrogen, and carbon monoxide.

The Venus Atmosphere and Clouds -- A Probe's-Eye View

If passengers could be placed on the four Pioneer Venus probes as they descended through the atmosphere, this is what they would probably experience:

Riding the Day Probe from space down into the Venus atmosphere, a passenger would first cross the bow shock wave in the one-million°C (1,800,000°F.) solar wind at about 7000 km (4650 mi.) from the Venusian surface.

He then would pass through the turbulent transition region before reaching the top of the ionosphere at about 400 km (240 mi.) altitude.

Moving down through the tenuous upper atmosphere, a passenger would see far below yellowish surfurous clouds, which, along with the dense atmosphere, reflect 75 per cent of the sunlight away from the planet. As the probe passes the turbopause at 144 km (90 mi.), the clouds appear 76 km (47 mi.) below as a dense, smog-like haze.

Venus' cloud region begins at about 70 km (43 mi.) altitude and extends for 20 km (12 mi.) to 47.5 km (30 mi.) altitude.

The Sun begins to grow dim at about 66 km (41 mi.) from the surface. By 63 km (39 mi.) altitude, the Sun is no longer a visible disc behind the diffuse yellow cloud layer made up of tiny sulfuric acid particles. Visibility through the high Venusian smog at that height is about 6 km (4 mi.) and the temperature is 13°C (55°F.). The atmospheric pressure is about one-half that at Earth's surface.

At 49.5 km (31 mi.) altitude in a mild temperature of 20°C (68°F), a passenger could see about a mile. After passing a short, clear space in the hazy cloud layers, the probe enters the bottom layer where the atmospheric pressure is about equal to that at the Earth's surface. The temperature rises to about 202°C (395°F.) Here the sulfur clouds are densest, with a few of the 1-micron sulfuric acid particles and many large 10-15-micron particles of sulfur. These are the only Venusian clouds dense enough to look like cloud structures on Earth. All other Venusian "clouds" are made up of particles so dispersed that they look more like haze.

Beneath this dense sulfur cloud, there is a second clear space and a "pre-cloud" layer of a few hundred meters, which is similar to the top cloud layer. The probe passenger would see a faint haze at about 47.5 km (29 mi.) altitude.

As the haze clears away at about 30 km (19 mi.), the atmosphere becomes clear of particles. Visibility in the dispersed light coming through the yellowish clouds is 80 km (50 mi.). Illumination is comparable to a bright cloudy day on Earth. Temperature at 30 km (19 mi.) is about 310°C (590°F.).

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At 20 km (12 mi.) altitude, where the temperature is 380°C (716°F.), the light becomes redder. Because of light scattered by Venus' thick atmosphere, visibility is down to around 20 km (12 mi.). At 10 km (6 mi.) altitude, the light is quite red and horizontal visibiltiy is only 12 km (7 mi.). Illumination is gloomy and the temperature is a scorching 410°C (770°F.).

At about 7 km (4 mi.) altitude, some surface features begin to become visible in the red murk below.

Landing on the surface, where the temperature is about 453°C (847°F.), and only 10 per cent of non-reflected sunlight is reaching the ground, the passenger cannot tell where the Sun is located in the sky. Illumination is red with much refraction and distortion of landmarks. Only the longest red wavelengths travel any distance through this atmosphere which is 91 times as dense as the atmosphere at the Earth's surface. Visibility in this dense carbon dioxide atmosphere is about 3 km (1.5 mi.). Overhead illumination is still comparable to a gloomy day on Earth.

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Where Is the Venus Water?

Other Pioneer Venus findings bear on what happened to Venus' water vapor (if the planet ever had any) and on comparisons with the Earth's atmosphere.

Measurements showed that the Venus atmosphere has about the same amount of nitrogen as Earth's atmosphere.

Both planets have roughly equal amounts of carbon dioxide, but most of Earth's is locked in carbonate rocks. Venus' carbon dioxide makes up 97 per cent of its atmosphere.

The findings of .1-.4 per cent of water vapor and 60 parts per million (ppm) free oxygen will help tell us whether Venus originally had abundant water and lost it--or never had much water. Many scientists think Venus' primordial water circulated to the top of the atmosphere where solar ultraviolet broke it down into hydrogen and oxygen. As the lightest element, hydrogen then escaped to space. (The Pioneer measurements show such low hydrogen-escape rates today that water loss, if it did happen, has long since ceased.) If massive water loss did occur this way, where is the left-over oxygen?

If Venus has an Earth-like geology, as the early Pioneer results suggest, the oxygen could be locked up in the planet's crustal rocks, as carbon dioxide is on Earth. An Earth-like geology would mean that much of the surface rock has been overturned to deep levels by crustal folding and other movements over the past three billion years.

The Solar System is calculated to be 4.5 billion years old. This allows 1.5 billion years for water breakdown and hydrogen loss, plus three billion years for the left-over oxygen to combine with surface rocks. Quantity calculations for oxygen reactions such as conversion of ferrous to ferric iron show the oxygen could be locked up in Venus' rocks.

Solar Wind Interactions

Experimenters found the interaction of the solar wind with the planet's ionosphere was several times more powerful than expected. The planet's bow shock wave in the solar wind was very strong with powerful upstream plasma waves in front of it, out a distance of several planet diameters. Since Venus has little or no magnetic field, the solar wind is not swept away from the planet as it is at the Earth, but interacts directly with the top of the Venus atmosphere and ionosphere.

Earth's bow shock wave is typically 65,000 km (40,000 mi.) out at the nose of the shock. Venus' bow shock was found to lie typically eight times closer, at 8,000 km (4,200 mi.) out. Top of the Venus ionosphere appears to average about 400 km (240 mi.) out, while the sensible atmosphere begins at 250 km (150 mi.).

The region between the bow shock and the top of the ionosphere is typically about 7,500 km (4,650 mi.) wide at the nose of the shock. Both the solar plasma and the magnetic field in this region were very turbulent and very high in temperature, about 1 million °C (1.8 million °F) or many times the comparable temperatures in the region near Earth. At the ionosphere's top, experimenters found relatively strong magnetic fields. The Venus ionosphere also was very responsive to solar wind pressure. The pressure deformed the ionosphere, moved it in and out, or both.

Unexpectedly, the solar wind is held off at least as strongly by Venus' ionosphere as it is by the Earth's magnetosphere. It was not believed that Venus' ionosphere alone, with little or no planetary magnetic field to help, could do the job as well. (The holding off is actually done by the magnetic field induced in Venus' ionosphere by the solar wind motion relative to it.)

Interaction Mechanisms

Differences have been found between Venus' and Earth's solar-wind interactions. At Venus, the wind confines the ionosphere below a well-defined boundary, the ionopause. The Earth has no such boundary. Pioneer observed varying heights for the ionopause with solar wind changes.

During the first week of orbit, wind speed slowly fell from 500 to 250 km/s (from one million to a half million mph). In response, the ionopause slowly rose from 250 to over 1,500 km (155 to 930 mi.). When a solar flare raised solar wind speed to 600 km/s (1.3 million mph), it increased its pressure on the ionosphere 10 times. The ionopause was crushed back down to 250 km (165 mi.).

Some solar wind ions seem to penetrate below the ionopause, heating the electron temperature to 5,000°K (8,500°F). It would otherwise be only 1,000°K (1,300°F).

Structures of the upper atmosphere and ionosphere are dominated by three important heights, all measured for the first time by the Pioneer Bus.

The <u>turbopause</u> at 144 km (90 mi.) is the boundary above which gases separate by density to form layers of different compositions. Below the turbopause, mixing stirs all the gases uniformly together. The <u>maximum ion density</u> of the ionosphere is also at 145 km (90 mi.). Ion density falls off very rapidly below this altitude. Here, the most abundant ions are O_2^+ and CO_2^+, but O^+ takes over from shortly above ion maximum all the way to the top of the ionosphere.

The exobase, the bottom of the exosphere, the region from which gas molecules escape into space, is at 160 km (100 mi.). Thus, turbopause, ion maximum, and exobase heights almost coincide. By contrast, on Earth, these heights are at 100, 300, and 550 km (60, 120, and 350 mi.), respectively.

Venus' Ionosphere

Venus has an ionosphere on its night side. Previously this was a mystery because solar ultraviolet and X-rays do not reach the night side to form an ionosphere during Venus' 58-Earth-day-long nights. Pioneer findings of extremely long-lived metal ions of meteoritic origin (iron and magnesium) may be a discovery that explains Venus' night ionosphere.

Ions found in the ionosphere were molecular oxygen, atomic oxygen, carbon dioxide, carbon monoxide, atomic nitrogen, carbon hydrogen, helium, iron and magnesium.

Succeeding months should bring more Pioneer findings. Some will be: calculation of Venus' winds along all four probe flight paths, with accuracy "fine-tuned" by the 67-minute survival of the Day Probe on Venus' surface. Others should be further atmosphere composition analysis and composition analysis of a cloud droplet that entered the mass spectrometer on the Large Probe.

The orbiter will be returning pictures and other data on the planet and its interior for a year.

The Pioneer spacecraft are managed by NASA's Ames Research Center, Mountain View, Calif. The spacecraft were built by the Hughes Aircraft Co., El Segundo, Calif.

First scientific papers on Pioneer Venus findings will appear in the February 15 issue of Science.

(This information also being released by the NASA Ames Research Center, Moffett Field, Calif.)

- end -

NASA News

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Release No. 79-09

NASA AIRCRAFT TO SCAN SOUTHERN SKIES

The speed of the Earth traveling through space will be charted by a NASA high altitude scientific research aircraft operating with the approval of the Government of Peru out of Jorge Chavez Airport near Lima beginning about March 2.

The aircraft is expected to arrive at Jorge Chavez Airport on March 1 and will make four evening scientific flights from there. Flights from Jorge Chavez Airport will all be over international waters and Peruvian air space.

The aircraft, a Lockheed U-2, will carry as its only payload an upward-looking differential microwave radiometer. The radiometer is a device for measuring tiny differences in the universal background microwave radiation at extremely low temperatures simultaneously in two different parts of the sky (60 degrees apart).

These measurements are then used to measure the movement and speed of Earth and our Galaxy, the Milky Way, with respect to the far distant matter of the universe. These measurements are based on the theory that microwave radiation

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February 21, 1979

emanated from the creation of the Universe some 15 billion years ago in a "big bang" or explosion, and that all the matter in the Universe has been and is still expanding. Similar measurements made by the same aircraft and experiment in the Northern Hemisphere in 1976-77 support these theories and the belief that our Milky Way and Earth are traveling through space at 1.6 million kilometers per hour (1 million miles per hour). Earth seems to be moving in the direction of the Constellation Leo or the star Regulus.

The scientific experiment team will be represented in Peru by Drs. George Smoot and Phil Lubin of Lawrence Berkeley Laboratory of the University of California. Dr. Luis W. Alvarez, Nobel prize-winning physicist of the University of California at Berkeley, was an early sponsor and enthusiastic proponent of these experiments. These scientists need this expedition to Lima to obtain coverage of the Southern Hemispheric celestial areas. The results of the Lima night flights will be compared with the previous experiments conducted in the Northern Hemisphere, with the goal of further substantiating evidence that the "big bang" theory is correct.

Simultaneous measurements will be made by a ground-based instrument which measures the polarization (directions of vibration) of the cosmic radiation - the remnants of the microwave radiation that emanated from the "big bang" - as a further test of these theories.

The NASA team in Peru, headed by James Cherbonneaux, Chief of the High Altitude Missions Branch at NASA's Ames Research Center, Mountain View, California, will consist of about 18 NASA and Lockheed Aircraft Company personnel.

The scientific payload, including support equipment and the radiometer, weighs about 135 kilograms (300 pounds). During the science mission, the aircraft will fly 160-km (100-mile) legs at right angles to each other at a latitude of about 16 to 17 degrees south. The radiometer will collect data at two different points in the sky during each four-hour mission. With four missions planned, the radiometer will cover eight different celestial areas and the total coverage could be as much as two-thirds of the Southern Hemisphere.

The U-2 was chosen for the experiments because it can fly at altitudes as high as 19,500 meters (65,000 feet) where the extremely low atmospheric water vapor will not significantly affect the measurements.

Lima, Peru was chosen by the scientific and operational team members as the best operational base for the aircraft because from there the aircraft can reach the southern latitudes necessary to obtain the required data.

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Scientific results and conclusions of the 1976-77 flights over the United States have been published by the experiment team in the May, 1978 issue of SCIENTIFIC AMERICAN and in PHYSICAL REVIEW LETTERS, October, 1977. Results from the Peru-based expedition will be published in similar scientific journals when analysis is complete.

- end -

February 21, 1979

NASA News

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75th ANNIVERSARY OF POWERED FLIGHT * 1903-1978 *

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Release No. 79-12

PIONEER VENUS INTERIM RESULTS

4-19-79

Dramatic Pioneer Venus Findings

Interim findings from the Pioneer Venus Orbiter and Multiprobe missions include:

· A 15,000-foot-deep, 900-mile-long rift valley, the largest canyon yet found in the solar system

· Confirmation of what appear to be periods of virtually continuous lightning in the atmosphere and of a continuous strange glow at night near Venus' surface

· Evidence for a 650-mile-wide, roughly-circular region of down-flowing winds over the poles, perhaps a key mechanism in Venus' global atmosphere circulation

· Dramatic new pictures of the planet

· Unique, perhaps planet-spanning, "magnetic rope" structures in Venus' ionosphere

Venus' newly-found rift valley is three miles deep and 175 miles wide. Pioneer radar mapper measurements found the canyon to be at least 900 miles long with no apparent beginning or end. This geologic feature is deeper than anything on Earth and appears larger than Valles Marineris on Mars, previously the solar system's largest canyon.

The Russian Venera spacecraft found continuous lightning activity from 32 km down to about 2 km altitude, with discharges as frequent as an amazing 25 per second. The Pioneer Orbiter also observed this lightning, measuring such discharges during every pass across the planet's night hemisphere.

The eye would not be able to separate such frequent flashes and an observer on Venus might see the landscape and dense atmosphere bathed in a continuous, eerie electrical glow, accompanied by continuous peals of thunder.

Pioneer experimenters, Dr. Boris Ragent, Ames Research Center, and Dr. Jacques Blamont, University of Paris, now believe that the "mysterious glow" measured by their instruments is real light on Venus, and not something happening on the spacecraft. The glow started at about ten miles altitude, and increased as the two night-side probes approached the surface.

"Chemical fires" due to reactions of various compounds in the super-heated atmosphere close to, or on, Venus' surface have been cited as a possible source for the glow. Pioneer measurements suggest a "chemical stew" near the surface whose reactions could fuel such "fires."

Lightning discharges also are a possible source of this glow, except that the increasing intensity observed going down would be unlikely for lightning, as would be the very steady character of the glow.

The Pioneer Orbiter's infrared radiometer has found both a depression in the clouds at the north pole, and an actual 1100 km (682 mile-wide) hole where there were few or no clouds. This finding strongly suggests a downflow of atmosphere at the pole. There also is evidence for such planet-wide atmosphere flow in temperature measurements made by the Pioneer Sounder Probe at the equator and the North Probe at 60° north latitude.

New probe findings also show that before the clouds Venus atmosphere is remarkably uniform in temperature and pressure at all latitudes and in both day and night hemispheres.

The new Venus pictures provide a sequence showing global cloud movements. They show, among other things, that Venus' planet-spanning C- and Y-shaped dark markings result from dark clouds (probably sulfur) below the highest cloud layer.

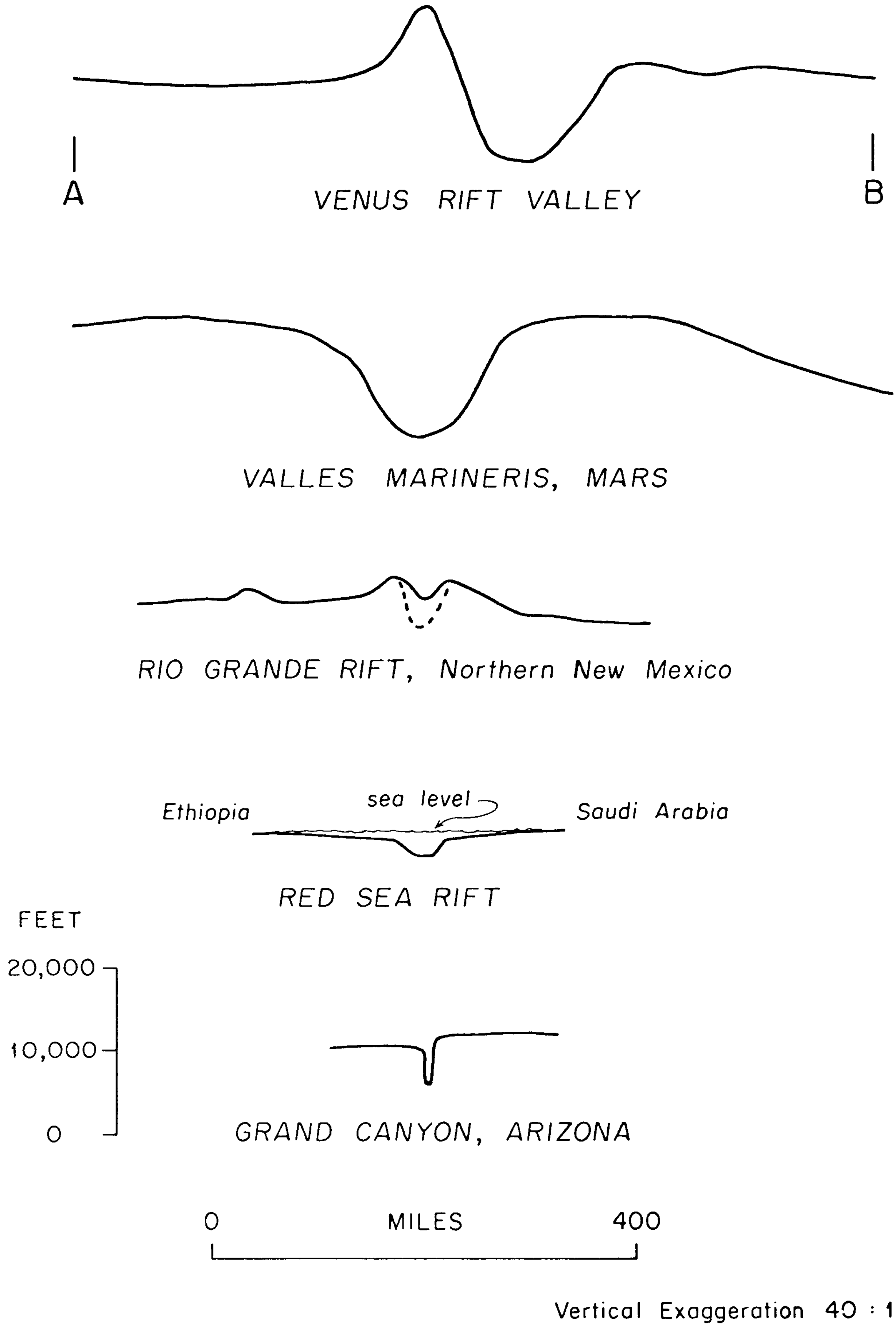
The interplanetary magnetic field appears to be compressed, wrapped around itself, and twisted into unique magnetic ropes within Venus' ionosphere, results show.

Venus' Record-Breaking Canyon

Venus' huge valley, the largest yet found in the solar system, is much deeper than similar formations on Earth, where most valleys have been formed by erosion rather than by fault activity. The features on Mars and Venus may indicate that the two planets have undergone much different activity than that experienced by Earth.

The canyon's shape suggests to scientists that internal planetary forces have broken open Venus' crust to create the formation, because erosion or the impact of a meteorite would not be likely to cause such a long, linear feature. Also, Venus' canyon is interrupted every 30 to 60 miles by offsets which appear to be similar to the transverse faults in most rift valleys on Earth. Rift formations on Earth include the Rift Valley of East Africa and the Mid-Ocean Ridge. Scientists were unable to tell when the Venus fault activity occurred or whether the internal forces are still at work.

The Radar Mapper, which had malfunctioned during the second month of orbit, now has completely recovered both its altimetry and imaging capabilities.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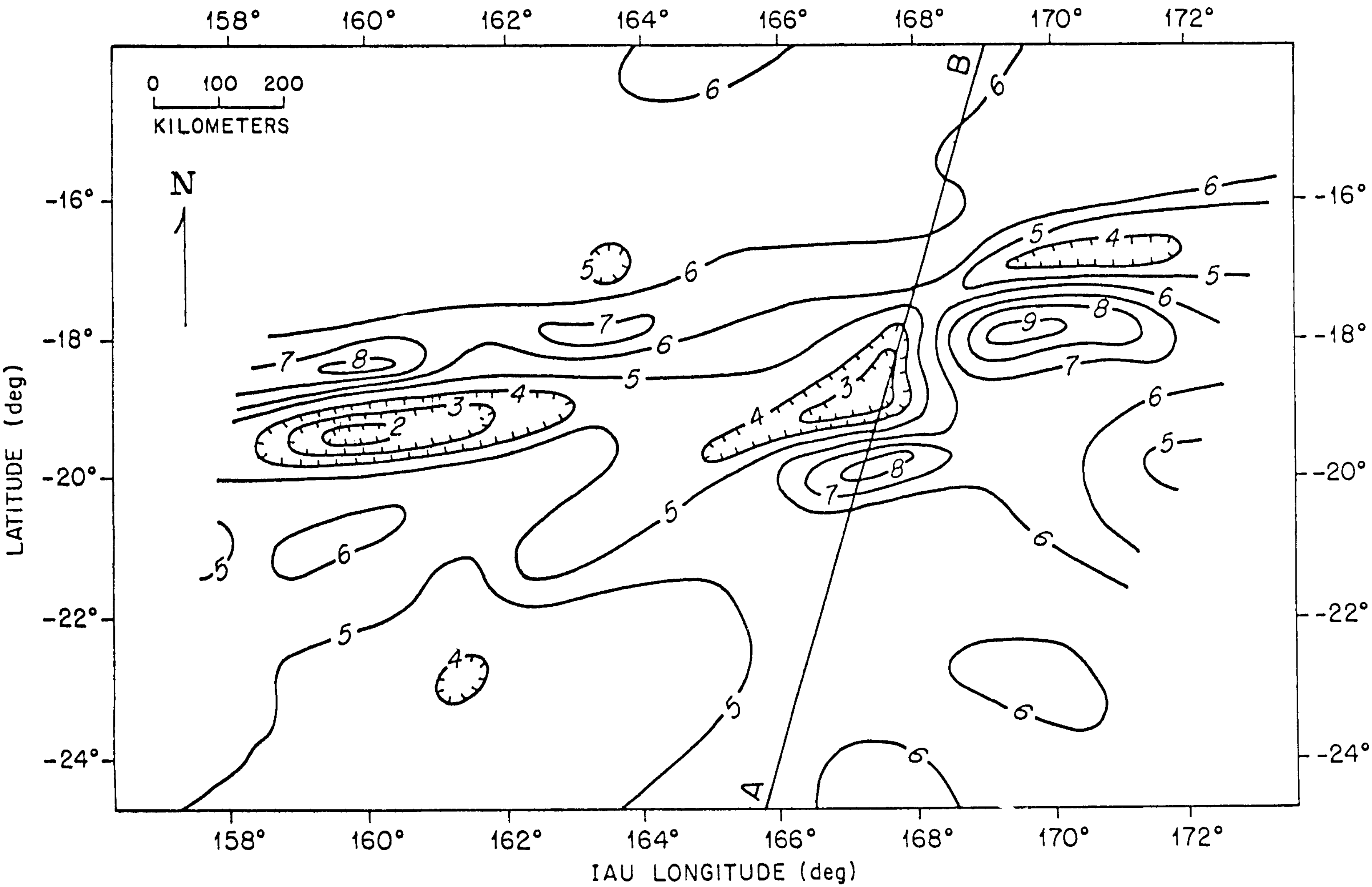

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Radar

Scientists soon will have the long-anticipated visual radar images of Venus' surface. The Orbiter radar instrument worked normally for the first 10 days of orbit in December, but by mid-December the data had become degraded.

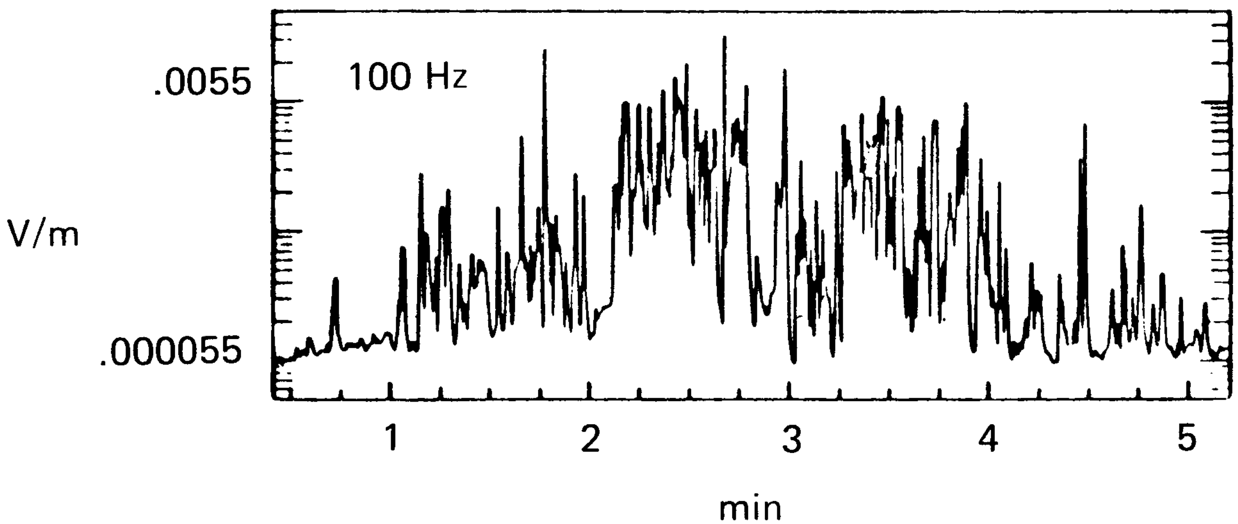
When examined in early January, the instrument was recycling at 49 pulses instead of completing the required 64. Believing the cause to be either a temperature or charge build-up, controllers turned off the instrument. On January 20 it was again turned on and had improved considerably. Experimeters then had the instrument turned on once daily during its two-hour operation period. By January 29 the altimetry mode had fully recovered, and on February 14 the imaging began to perform normally.

Altimetry data provide heights of terrain on Venus, mapping a belt around the planet which spans 130^{o} of latitude. Recording areas of the planet not visible from Earth-based instruments, the radar will cover latitudes from 75^{o} north to 63^{o} south, revealing surface characteristics of geographical features.

Continuous Lightning Confirmed

The Soviet Union's Venera spacecraft, which entered Venus' atmosphere in late December, detected 13 minutes of electromagnetic signals similar to terrestrial lightning storms. The signals began at about 32 km and ended at about 2 km. At times, the Soviet spacecraft detected as many as 25 strokes of lightning per second--an essentially constant bombardment of Venus' atmosphere.

Lightning measurements on Venus, electric field detector, Pioneer Orbiter – January 21, 1979



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Thirty-two minutes after landing, Venera 11 acoustic equipment detected a very loud (82 db) noise which is believed to have been thunder.

The first U.S. detection of lightning came on December 30, 1978, when the Pioneer Venus Orbiter instruments picked up intense and highly impulsive electric field signals characteristic of terrestrial lightning. Detected during the first day that the Orbiter's point of closest approach occurred on the night side of Venus, the signals were picked up near that closest point.

Scientists said the lightning signals, which are well below the ionopause, are detectable either because they are coming through "holes" in the ionosphere, or because they are "whistler" signals which are able to pass through the ionosphere. Whistler radio waves on Earth are generated by lightning or by high-energy electrons.

The Polar Hole

Major findings also have come from infrared observations.

The 1100 km (682 mi)-wide clear area in Venus' clouds is located near the center of the north polar vortex.

Dr. Fredric Taylor, Jet Propulsion Laboratory, attributes this relatively small "polar hole" to strong downflow in the atmosphere. This would drive the polar clouds down to lower, hotter levels where they would evaporate and may disappear entirely.

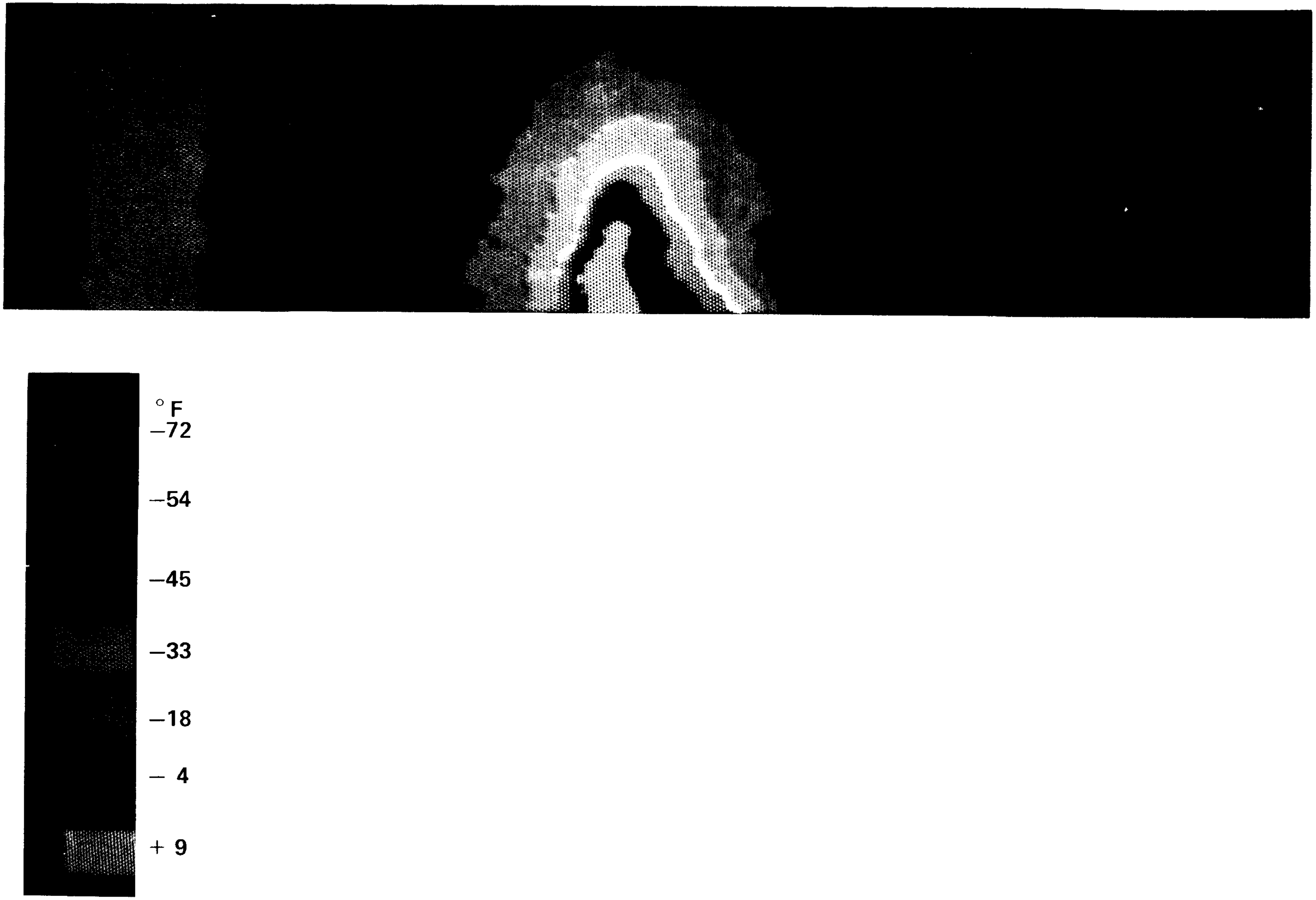
The Pioneer Venus data on the planet's winds is not yet available. However, if the apparent down-flow of wind at the poles is real--and is powerful enough to sweep away most of the clouds--it may provide a key piece in the puzzle of the global circulation of the planet's atmosphere.

The Pioneer Sounder Probe at Venus' equator and the North Probe near the pole, combined with the infrared instrument, have made related significant findings.

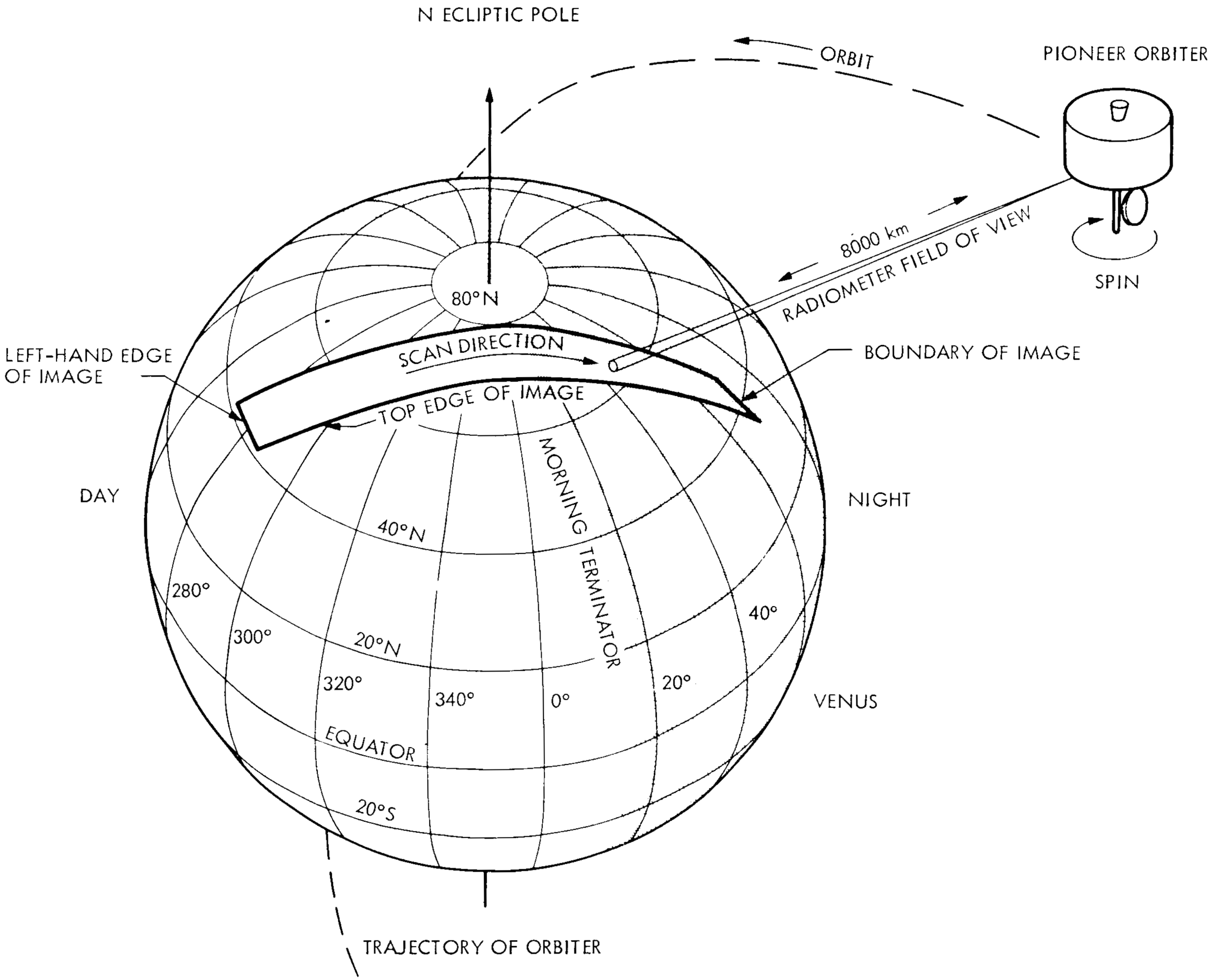
In the atmosphere above the clouds (from 70-90 km altitude, Venus' stratosphere) temperatures increase going from equator to poles. (Solar heat comes in to Venus mainly at low latitudes, so the unheated polar regions should be cooler.) If instead the poles are hotter, an equator-to-pole circulation and downward polar flow is hard to explain.

However, the two Pioneer probes found that below the clouds, at around the 60 km level, this trend reverses, and the polar regions are indeed cooler.

INFRARED VIEW OF VENUS' "POLAR HOLE"



TRACK OF PIONEER INFRARED SCANS ACROSS VENUS' NORTH POLAR REGION



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The attempt to put the North Probe into the circumpolar cloud region was successful. The North Probe found that at 60 km altitude, polar temperature was 30°C lower than temperature measured at the equator at the 60 km altitude level by the Sounder Probe.

According to Alvin Seiff, Ames Research Center, this reversal in equator-to-pole temperature patterns at 60 km altitude suggests two circulation cells: An equator-to-pole cell in the lower atmosphere and a pole-to-equator cell in Venus' stratosphere (above 60 km) driven by the massive equator-to-pole circulation cell lying below it. The down-flow at the pole is part of the lower cell, driven by the 30°C temperature difference between the equator and 60° north latitude. The upper circulation cell can explain why the polar stratosphere is warmer than that near the equator.

The cloud top temperatures increase from the equator to mid-latitudes, then cool down by as much as 40°C at about 70°N latitude (20° from the pole). The temperatures increase again over the poles to their mid-latitude values.

The cool region at 70° north latitude is a ring of cold, high clouds around the pole. North of this ring, there is a polar depression in the clouds about 15 km deep. This depression is about 3000 km in diameter, three times wider than the planet's relatively cloud-free polar hole.

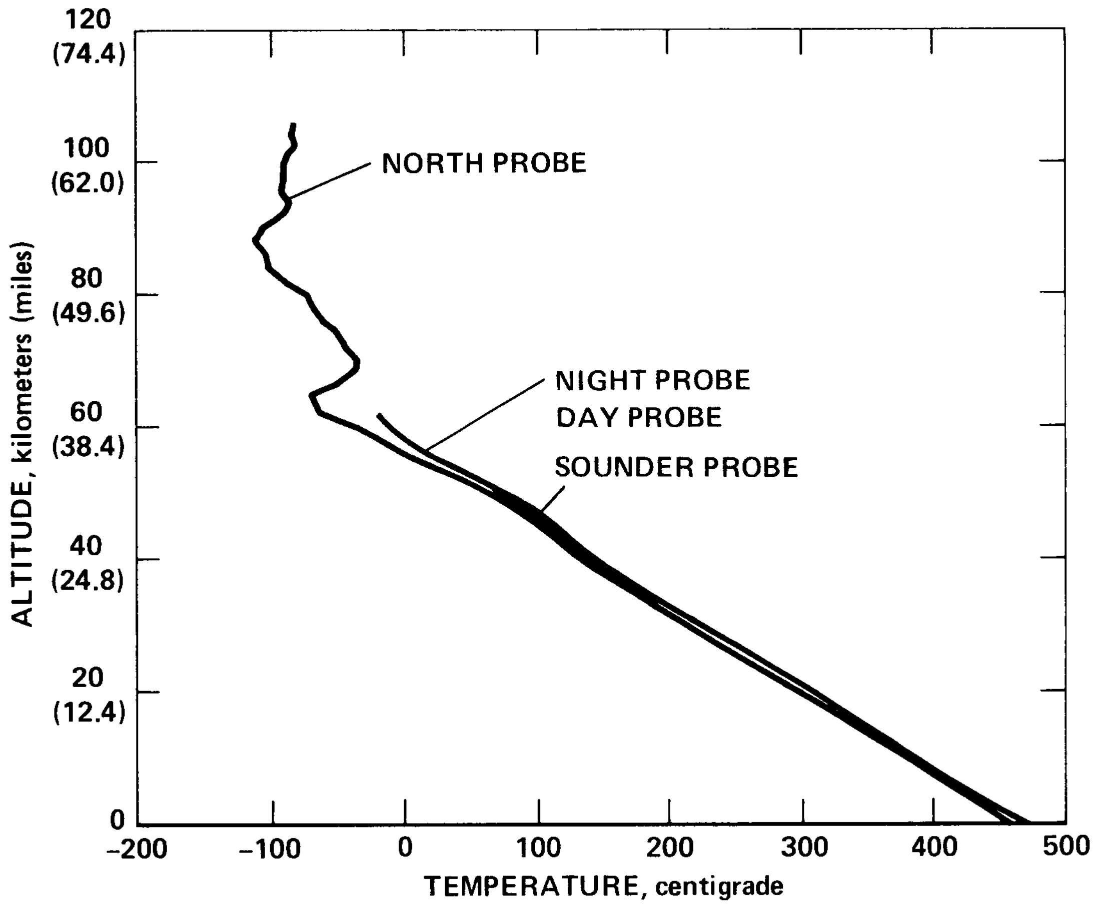
Global Atmosphere Findings

Temperature and pressure profiles from all four probes (two on the day side and two on the night side) now show that conditions in Venus' atmosphere beneath the clouds are startingly uniform. Over the entire cross section of Venus' atmosphere from the cloud tops, down to the surface, a vertical distance of 50 km (30 mi), these profiles coincide almost exactly. This means that atmospheric temperature and pressure in most of the atmosphere (99 percent of it) are almost identical everywhere on Venus--at the equator, at high latitudes, and in both the planet's day and night hemispheres. This, in turn, means the Venus weather machine is very efficient in distributing heat evenly.

The Venus probes also found somewhat milder than expected conditions at the surface. Temperature at 457°C (854°F) instead of 492°C (917°F) was 63°F lower than expected. Pressure at the surface also was lower than expected--about six earth atmospheres lower, 90.5 instead of 96.5 atmospheres.

It now appears that the characteristic planet-spanning C- and Y-shaped dark markings in pictures of Venus taken in ultraviolet light are due either to global breaks in the bright, highly reflective upper cloud deck or to massive upwellings of sulfur compounds to altitudes where they can be seen through the thin upper clouds. Dr. Ian Stewart, University of Colorado,

VENUS' TEMPERATURES COINCIDE GLOBALLY



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reports that his ultraviolet spectrometer apparently has seen a new aspect of these lower, dark, cloud features. He has identified sulfur dioxide clouds which seem to coincide closely with Venus' global patterns of C- and Y-shaped dark markings.

The dark markings in the Venus ultraviolet pictures are still believed due to absorption by elemental sulfur. However, the Pioneer atmosphere measurements suggest that sulfur dioxide and sulfur should be found together in the clouds, as part of the atmospheric sulfur cycle (which may be something like Earth's water cycle). Therefore, the huge sulfur dioxide clouds reinforce the idea of a regular pattern of planet-spanning breaks (or upwelling features) in Venus' upper cloud layer. The presence of sulfur dioxide in these patterns also suggests flow or regular wave motions in the planet's atmosphere.

Venus' Sulfur Cycle

Although much more work is needed, scientists now believe the basic sulfur cycle in Venus' clouds goes something like this:

Sulfuric acid droplets together with liquid and solid sulfur drift down through the clouds heating up as they go. At the bottom of the densest cloud layer (48 km), the material begins to vaporize and split up.

The breakdown products, water, sulfur dioxide, oxygen, and various sulfur compounds - then recirculate up through the clouds, where they are reformed into sulfuric acids and sulfur through reactions that probably involve solar ultraviolet radiation. The absence of free oxygen and water vapor in the upper atmosphere indicates that these two compounds are being removed by vigorous reactions within the clouds.

New Planet Pictures

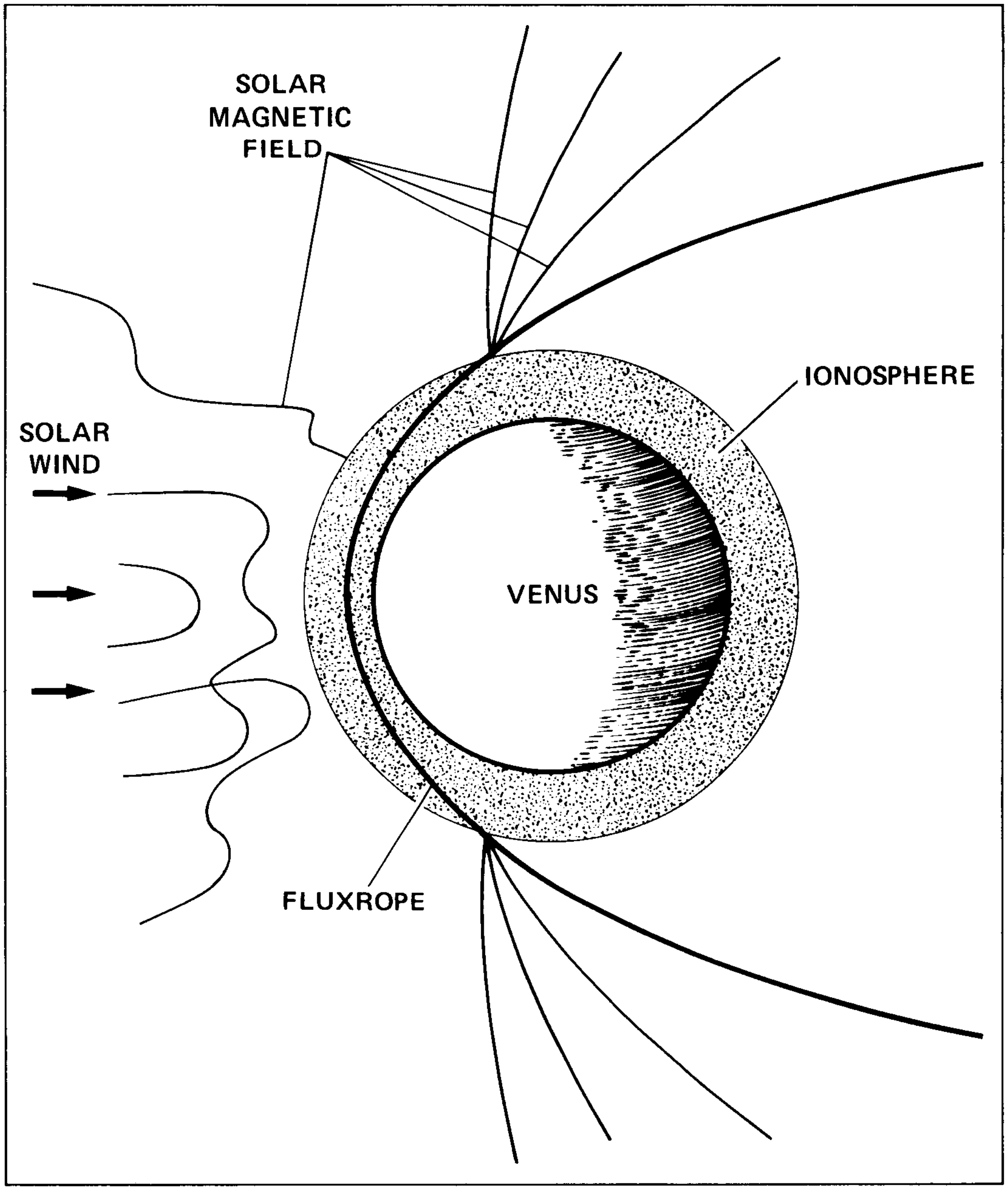
Pioneer Venus Orbiter now has taken well over 200 pictures of the cloud patterns.

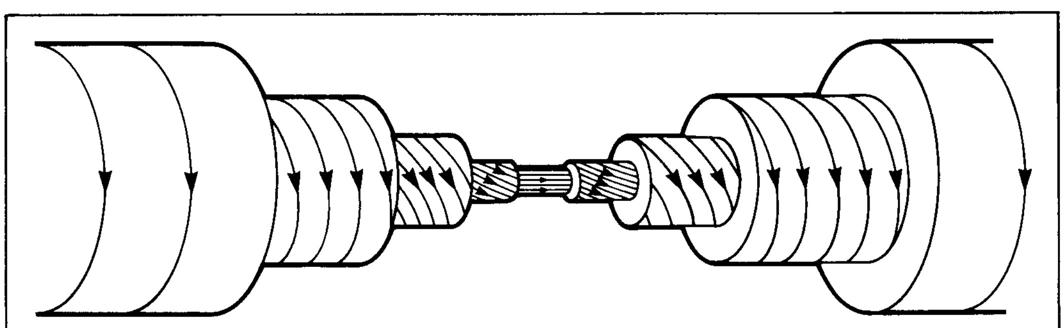
These show that Venus' dark markings are below the reflective upper cloud layer and that the clouds near the poles currently are much thicker, and hence ten times brighter than they were during the Mariner 10 flyby in 1974. Pictures also show that one of the planet's characteristic Y-shaped features has moved through the sub-solar (sun-facing) point on Venus' cloud tops in recent weeks. Previously, it had been thought the "Y" features may be directly related to the sub-solar point.

There also appear to be many more circular cells than previously observed and some new types of cells. These may be convective cells something like Earth's thunderstorms.

Magnetic "Ropes" Above Venus

Unique magnetic field structures have been detected for the first time in Venus' ionosphere by the Orbiter Magnetometer instrument. Twisted magnetic field lines, wrapped around each other like woundup ropes, appeared as spikes in the Magnetometer readings, sometimes as intense as the built-up solar wind magnetic field outside the ionosphere. Because Venus does not have a magnetic field, the solar wind constantly bombards the top of





INTERIOR STRUCTURE OF FLUXROPE

Venus' ionosphere. When the solar wind encounters the obstacle of this ionosphere, most of it flows around the planet, but the solar wind magnetic field tends to build up at the boundary. Scientists suggest that the solar wind magnetic field may be diffusing through the ionosphere in these twisted, rope-like field lines.

Another theory is that the magnetic-field spikes are induced in the ionosphere by electric current flows in the solar wind.

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75th ANNIVERSARY OF POWERED FLIGHT * 1903-1978 *

Mar 16

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Evvie Rasmussen 415/965-5091

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Release No. 79-13

PIONEER VENUS TEAM AND MANAGER CHARLES HALL
WILL RECEIVE NATIONAL SPACE HONORS

The NASA-Ames Research Center Pioneer Venus team and its manager Charles Hall will be honored for outstanding contributions to space science at the National Space Club's Annual Goddard Memorial Dinner on March 30.

The Nelson P. Jackson Award, given to the year's most outstanding contributor to the missile, aircraft and space field, will be presented to the Pioneer Venus team at the club dinner in Washington, D. C. Named for a founder and past president of the National Space Club, the award will be given jointly to NASA-Ames Research Center for management of Pioneer Venus and to Hughes Aircraft Company, which built the Pioneer Venus Orbiter and Multiprobe.

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March 16, 1979

Hall, who has managed the Pioneer Projects since their inception in 1962, will also be awarded the Annual Astronautics Engineer Award at the Goddard dinner, named for Dr. Robert H. Goddard, builder of the first rocket.

In a further recognition, Hall will address the 74th Annual Explorers Club Dinner in New York City on March 31 describing the Pioneer Venus mission.

The Pioneer Venus Orbiter, which now has circled the planet more than 100 times, entered its orbit of Venus on Dec. 4. Since then it has sent back data and photographs of the cloud-shrouded planet, including radar maps of huge canyons and measurements of lightning storms in the Venus atmosphere, and planetary circulation.

The Pioneer Venus Multiprobe split into four probes and a transporter bus in mid-November. The five craft then entered Venus' atmosphere on Dec. 9, sending back extensive data from the top of the atmosphere to the surface of the planet at points spread 6,000 miles apart over Venus' Earth-facing hemisphere. Although not designed to survive impact with the planet, the Day Probe sent back data from the surface for 67 minutes, providing experimenters with a bonus of information about Venus' atmosphere.

For management of Pioneers 6, 7, 8 and 9 which now are orbiting the Sun, Hall received the NASA Exceptional Service Medal in 1967. The success of the Pioneer 10 and 11 flybys of Jupiter earned Hall the NASA Distinguished Service Medal in 1974. On Sept. 1, Pioneer 11 will become the first spacecraft to fly past and photograph the planet Saturn. Pioneer 10 now is headed out of the solar system. Pioneer 11 also will leave the solar system after its encounter with Saturn.

Born in San Francisco in 1920, Hall joined Ames in 1942 after receiving a bachelor's degree in mechanical engineering from the University of California, Berkeley.

Hall lives with his wife, Connie, in Los Altos, Calif.

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U.S. AND USSR TO CONDUCT JOINT SPACE MEDICINE STUDY

NASA and Soviet life scientists will join for the first time in a ground-based cooperative study to investigate physiological changes in humans resulting from simulated weightlessness.

Objectives of the joint study are to improve bedrest test procedures to help standardize physiological measurements and analysis techniques performed on astronauts and cosmonauts, and to help reduce test duplication and increase the flow of information between the two groups.

The project was established two years ago under the auspices of the joint U.S./USSR Working Group on Space Biology and Medicine. Dr. Gerald Soffen, NASA Director of Life Sciences and Dr. N. N. Gurovsky of the USSR Ministry of Health are co-chairmen. The project involves Dr. Harold Sandler of NASA's Ames Research Center as project scientist, Dr. Carter Alexander of the Johnson Space Center as project

- more -

April 13, 1979

manager, and Ms. Dee O'Hara, R. N. as facility manager for the U.S. part of the project.

Many of the effects on individuals of the weightless environment of spaceflight can be simulated on Earth by bedrest. The research study includes two identical experiments, each involving 10 test subjects, ages 35 to 40 years. Each experiment will last five weeks, with two weeks of control observations, one week of bedrest, and two weeks of post-bedrest measurements.

Stress tests of the cardiovascular system, including response to exercise, and extensive blood and urine sample analyses will be performed.

Experiment procedures call for five test subjects to remain horizontal in a total bedrest condition, and for five to experience bedrest with their heads lowered six degrees from the horizontal. Previous bedrest studies in the United States have been conducted with the subjects in a horizontal position only. Soviet scientists have conducted studies with subjects placed both in the horizontal position and with subjects exposed to varying degrees of head-down tilt. The current studies will determine the best features of each procedure.

The first five week study will be conducted at the Institute of Biomedical Problems in Moscow, beginning in mid-May. The second will start at the Ames Research Center in mid-July. There will be an exchange of NASA and USSR life scientists during each of the experiments.

Members of the U.S. team will include scientists from several universities. Edward Ifft, chief of the International Program Policy Office at NASA Headquarters, Washington, D. C., is coordinating arrangements with the U.S. Department of State and the Soviet Union.

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Aug 24

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Release No. 79-37

PIONEER SATURN BEGINS SENDING BETTER-THAN-EARTH

PICTURES OF RINGED PLANET

Spinning through space at 31,100 kph (20,500 mph) on Earth's maiden voyage to the ringed planet, Pioneer Saturn will begin on Sunday to transmit the first Saturn pictures which will be better than those taken from Earth. The spacecraft still will be five million km (three million mi) from the planet.

With Pioneer 1.5 million km (960 million mi) from Earth, deep-space networks in Madrid, Spain, Canberra, Australia, and Goldstone, California, will begin full-time, simultaneous tracking Saturday, which will double the data transmission rate, improving image quality.

On August 30, images taken 2 million km (1.3 million mi) from Saturn will be twice as good as any taken from Earth. On August 31, the last full-disc picture of the planet, taken from 1.6 million km (one million mi), will be five times better than Earth-based photographs. The closest picture, taken September 1 at 94,200 km (53,400 mi) above Saturn, will be 20 times better than Earth pictures, resolving cloud features 50 km (30 mi) wide.

- more -

August 24, 1979

The Imaging Photopolarimeter, Pioneer's camera equipment, already has transmitted more than 50 pictures of Saturn and its rings, some of which show the moons Titan and Mimas as tiny dots.

All images have been of the unlit side of Saturn's rings, a never-before-seen view. The rings have appeared in the negative, with dark rings and light shining through divisions between the rings.

Between August 26 and September 8, Pioneer will return 50 to 100 images which will be better than those taken from Earth.

The most critical event of the mission will occur at 9:01 a.m. Pacific Daylight Time on Earth September 1, when the spacecraft crosses the Saturn ring plane at 85,000 kph (53,000 mph). In less than a second, the spacecraft will pass through the ring plane at a point 112,000 km (70,000 mi) above Saturn. The crossing is dangerous because an impact with planetary debris outside the visible rings could destroy the spacecraft.

After the ring crossing, Pioneer will make the historic first flight under Saturn's rings, taking measurements to determine their structure. Pioneer will make its closest approach to Saturn at a distance of 21,400 km (13,300 mi) at 11:00 a.m. Ground Received Time at Pioneer Mission Control Center in Mountain View, California.

One minute after closest approach, Pioneer will disappear behind Saturn for 78 minutes, out of radio contact with Earth. After Pioneer comes out from behind Saturn, it will make another shallow-angle, hazardous ring plane crossing on its outbound journey on the afternoon of September 1, again 112,000 km (70,000 mi) above the planet.

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On September 2, Pioneer will take pictures of Saturn's giant moon Titan, which is bigger than the planet Mercury. After passing the ringed planet and nine of its ten moons, Pioneer Saturn will head out of the solar system, traveling roughly the same direction the solar system moves through the galaxy.

Pioneer carries a 30-kilogram (65-pound) scientific payload of 11 operating instruments. Two other experiments use the spacecraft and its radio signal as their instruments.

Pioneer Saturn is managed by NASA-Ames Research Center in Mountain View, Calif. The spacecraft was built by TRW Systems in Redondo Beach, Calif.

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August 24, 1979

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Release No.

U.S. EXPERIMENTS TO RIDE SOVIET SATELLITE

Thirteen United States experiments will be launched in mid-September aboard an unmanned Soviet satellite in the Cosmos series, along with experiments from the Soviet Union and several other countries. All the experiments are designed to test the effects of weightlessness on physiological processes.

Forty scientists representing 18 U.S. universities and research organizations will participate in the Cosmos project, which is managed in the United States by the NASA Ames Research Center in Mountain View, Calif.

The Vostok spacecraft, which will be launched and recovered within the Soviet Union, will be similar to those used on two previous Cosmos missions in 1975 and 1977, in which the U.S. also participated. Cosmos is inexpensive for the United States because the cost of the spacecraft and support activities is borne by the Soviet Union.

- more - September 7, 1979

The major 1979 Cosmos payload consists of 38 white rats and 60 fertile Japanese quail eggs provided by the Soviets and shared among participating experimenters. Placed in orbit for about three weeks, the animals will be studied upon return for the effects of weightlessness on their physiology.

The mission will include the first attempt to breed mammals in space. The Soviets will conduct the breeding experiment, separating male and female rats until the second day of flight, when the divider between the cages will be removed. In addition, the quail eggs will begin incubation on the eighth day of flight. Resulting embryos will be studied on recovery, some being allowed to reach maturity.

Three of the U.S. experiments involve materials which will be hand-carried to Moscow by U.S. scientists a week before launch. The scientists will return the recovered specimens to the Ames Research Center.

Materials from the U.S. will be carrot seeds and embryos, carrot slices inoculated with bacteria which can form tumors in plants, and film and plastic capable of detecting radiation encountered in space.

Of particular importance are U.S. studies of changes in animal muscle fibers and of animal bone formation, turnover and strength. These are expected to provide insights into the reasons for calcium loss in the bones and a loss of muscle strength experienced by astronauts and cosmonauts during prolonged space flights.

 September 7, 1979

After the flight, the animals must be recovered immediately, before they readapt to Earth gravity. As in previous Cosmos missions, the Soviet recovery team will move rapidly to the landing site and set up a mobile laboratory to perform dissections requiring immediate action. The remaining animals will be flown to Moscow, where some will be dissected after six days of readaptation to gravity, and the remainder after 25 days.

In Moscow, scientists will set up two groups of control animals identical to those going into space. One group will be left in cages and fed a normal diet. The other group, the synchronous control, will be housed in an identical spacecraft on the ground.

This group will be subjected to the same vibration and gravity forces of launch and reentry as the orbiting animals, then will experience any changes which occur in the orbiting craft as those changes are transmitted to Earth. This synchronous control will help ensure that differences between control and flight animals can be attributed to the experience of weightlessness.

Ames Research Center manages the U.S. portion of the Cosmos project for NASA's Office of Space Science. The NASA program manager is Robert Dunning. The project manager at Ames is Kenneth A. Souza and project scientist is Dr. Milton A. Heinrich.

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Fred Mascy 415/965-5897

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NASA SPONSORED CONFERENCE ON SATELLITE

INFORMATION FOR RESOURCE MANAGEMENT

More than 300 representatives of state and federal agencies, universities, national associations, and private industry will assemble in Monterey in mid-October to discuss progress in applying NASA's Landsat satellite technology to natural resource management.

The Regional Remote Sensing Conference, to be held October 17-19 at the Naval Postgraduate School, is the first gathering of such size for its sponsor, the Western Regional Applications Program at NASA's Ames Research Center. That program is now in its third year of transferring the use of the twin Landsat satellites to state and local agencies in fourteen western states. NASA's Goddard Space Flight Center and Earth Resources Lab are participating with Ames in the test to see if the satellite system can provide more immediate and cost-effective resource information than conventional data collection methods.

- more -

October 3, 1979

Participants in the three-day Monterey conference will address the political, economic, and social aspects of the technology's use, as well as actual applications in urban land use, forestry, and agriculture, and advanced analysis techniques and integration of the satellites' digital data into computerized information systems. Ames' Director C. A. Syvertson, Technology Applications chief Dr. Dale Lumb, and conference chairperson Fred Mascy will open the conference at King Hall. The first day's luncheon will feature a talk by Floyd Roberson, director of the Technology Transfer Division of NASA Headquarters' Office of Space and Terrestrial Applications, the organization guiding the transfer effort.

Key California speakers will be Dale Wierman of the State Department of Forestry; Glenn Sawyer of the Department of Water Resources; Mary Arbogast and Steve Kraus of the Environmental Data Center; Don Olmstead of the Association of Bay Area Governments; Drs. Jack Estes and Ida Hoos of the University of California; Donna Hankins of Humboldt State University; Greg Thornburg of Pacific Gas and Electric Company, and Ron Walters of COMARC.

Other speakers and panel leaders will represent western state governments, National Governors' Association, National Conference of State Legislatures, U. S. Geological Survey, Lockheed Electronics, Battelle, ESL, and Cartwright Aerial Surveys.

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PIONEER SATURN RESULTS ARE SUMMARIZED

NASA's Pioneer 11 spacecraft continues to work well after successfully flying past Saturn, the most distant planet yet reached in U. S. exploration of the solar system.

The space probe is now heading out of the solar system after returning the first closeup pictures of Saturn and making a number of important scientific findings, including the discovery of two new outer rings and possibly a new Saturnian moon. In addition, Pioneer sustained no damage from high-velocity ring particles showing that spacecraft can operate safely in the vicinity of the visible rings.

After a six-year trip of more than 3.2 billion kilometers (2 billion miles) in space, Pioneer spent 10 days photographing and measuring the ringed planet. As it made its closest approach, Sept. 1, to within 20,800 km (13,000 mi.) of Saturn's cloud tops at a speed of 114,500 km/hr (71,200 mph), some 1.6 billion km (1 billion mi.) from Earth, Saturn's gravity swung it almost 90 degrees on a change of course toward the edge of the solar system.

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October 24, 1979

Without a failure, Pioneer can return useful data until the late 1980s, when it reaches the limit of its radio contact with Earth.

Major findings about Saturn are:

- Saturn has an 11th moon. It was discovered in a photo taken of the outer edge of Saturn's rings and by instrumentation on board the spacecraft. Its estimated diameter is 400 km (250 mi.). It has been named 1979S1.

- Saturn has a magnetic field, magnetosphere and radiation belts. It joins Earth and Jupiter as a magnetic planet.

- Because of the low temperature measurements, evidence for the possibility of life on the planet's satellite Titan was discouraging, but not eliminated.

- Two new rings have been identified. One, which has been called the F ring, is separated from the A ring by a 3,600 km (2,240 mi.) gap, called the Pioneer division. The F ring was clearly visible in a closeup picture taken some 943,000 km (586, 000 mi.) away from the planet. A second ring, the G ring, also was discovered and lies between the orbits of the satellites Rhea and Titan or about 500,000 km (312,500 mi.) from the cloud tops.

- A feature called the French Division, a division between the middle and inner visible rings (B and C rings), was seen in Pioneer pictures of the shadow of the rings on Saturn's surface. It was named after French astronomers who first suggested its presence.

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• Substantial particle material was seen in Cassini's Division and in the outer and inner portions of the A ring. The Cassini Division looks empty when viewed from Earth, i.e., from the sunlit side of the rings.

• The B ring was found to be so opaque that it allowed almost no light to pass through it.

• The C ring was found to have few particles and appeared as diffuse as Cassini's Division.

• Pioneer found no evidence of either an innermost D ring or the expected outer E ring.

• Preliminary measurements of the ring mass indicate they have a low density. This suggests they are made up largely of ice.

• A substantial glow of atomic hydrogen was found around the rings which suggests absorption of protons from the radiation belts caused dissociation of water ice in the rings.

• Pioneer sustained two meteoroid hits above the rings and three more hits below the rings.

• Gravity field measurements indicate that Saturn is flattened about 10 percent at the poles by its rapid rotation and is not an oval body. It has a depression at mid-latitudes of about 120 km (99 mi.).

• Gravity field analysis and temperature profile measurements suggest that the planet's core, extending out about 13,800 km (8,575 mi.) from the center, is about twice the size of the Earth, but is so compressed by Saturn's huge mass that it contains about 11 Earth masses of material, largely iron and rock.

- Above the core, out about another 21,000 km (13,125 mi.), the measurements suggest that the planet consists of liquid metallic hydrogen, which does not exist on Earth. The presence of liquid metallic hydrogen is supported by the discovery that the planet has a magnetic field. To produce this field, a planet needs fast rotation and a liquid electrical conductor in its interior -- in Saturn's case, liquid metallic hydrogen.

- Two and a half times more heat is radiated into space by Saturn than is absorbed from the Sun. One interpretation of this observation is that perhaps only a third of Saturn's heat is generated by leftover heat of planet formation and by continuing gravitational contraction, with most heat being generated by denser helium sinking through the planet's liquid hydrogen interior. The upper atmosphere was determined to be $5^{o}C$ ($41^{o}F$.) warmer than expected.

- Saturn's magnetic field is 1,000 times stronger than Earth's and 20 times weaker than Jupiter's. The field is unique because its north-south axis lines up with Saturn's rotation axis, unlike the 10 degree tilt to the rotation axis of Earth, Jupiter and the Sun.

- Saturn has a magnetosphere, a magnetic "bubble" in the solar wind which surrounds Saturn, which is larger than Earth's, but smaller than Jupiter's. The nose of the teardrop-shaped magnetic envelope is usually about 1,250,000 km (775,000 mi.) from the planet. Its width is about 3,400,000 km (2,100,000 mi.).

• The planet has radiation belts made up of high energy electrons and protons which are comparable in intensity to those of the Earth, although the region they occupy is about 10 times larger. They are several hundred times weaker than Jupiter's.

• The radiation belts are completely eliminated by Saturn's rings because their high energy particles mirror back and forth between Saturn's poles about once a second, finally striking ring material which absorbs them. This is the most radiation-free sector of space yet found in the solar system.

• The moons Janus, Enceladus, and Tethys also absorb large numbers of radiation belt particles.

• Closeup pictures showed Saturn's cloud tops, unlike Jupiter's, have few details.

• Saturn's cloud tops appear to be lower at the poles than at the equator. As a result polar clouds were seen ranging from dark blue to slightly green and changing to brownish belts around 55 degrees latitude.

• There appear to be jet streams around 70 degrees latitude and overall the planet appears to have more and narrower belts and zones than Jupiter.

• Infrared instrumentation showed the equatorial zone cooler than adjoining higher latitude regions, and clouds of this zone are, therefore, probably higher. This suggests height and temperature differences between the belts and zones as expected.

● Ultraviolet instrumentation may have detected a generalized hydrogen glow or the presence of auroras on Saturn.

● Titan was found to have a cloud top temperature of -198°C (-324°F.). This very cold temperature eliminates an internal heat source as a means of warming Titan's surface, but leaves the possibility of atmospheric heating from a greenhouse effect.

● Light from Titan was found to be strongly polarized which is expected to allow determination of the kinds of aerosols or particles believed to be in the satellite's atmosphere.

● The ultraviolet instrument found a hydrogen cloud around Titan. This suggests its methane atmosphere is slowly breaking down into hydrogen and carbon, with the hydrogen escaping into space and carbon-based aerosols falling to the surface.

● Pioneer measurements are providing an improved mass and diameter for Titan. These measurements are expected to provide a density determination and estimates of its interior. Its density is believed to be low enough for it to contain significant quantities of interior ice.

● Titan has a magnetic wake within Saturn's magnetosphere. It extends ahead of the satellite instead of behind it, because of the planet's fast magnetosphere rotation.

The Pioneer program is directed by the Office of Space Science, NASA Headquarters, Washington, D.C. Project management is the responsibility of NASA's Ames Research Center, Mountain View, Calif. The spacecraft was built by TRW Systems, Redondo Beach, Calif.

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October 24, 1979

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Nov 21

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NEW SATURN DISCOVERIES BY PIONEER

A 12th moon of Saturn, a "new ring" around the planet, and a possible 13th Saturnian moon, have been announced following further analysis of Pioneer Saturn spacecraft data.

Pioneer Saturn completed the first trip to the ringed planet on September 1, 1979 after a two-billion-mile, six-year flight from Earth.

The discoveries were made known by Dr. James Van Allen, University of Iowa, a Pioneer investigator and discoverer of the Earth's Van Allen belts.

The new 12th moon, designated S-5, 1979, appears to be about 170 km (105 mi) in diameter, says Dr. Van Allen. It lies within the region occupied by Saturn's outer F-ring (also recently discovered by Pioneer), and its period of revolution around Saturn is about 15 hours.

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The planet's "new ring" is 8000 km (5000 mi) - wide. It directly adjoins the outer F-ring and could be considered an outward extension of the F-ring. However, this new ring region is 16 times wider than the F-ring, as measured optically by Pioneer. It also is made of more tenuous material than the F-ring.

In further findings, the Iowa group has made an independent confirmation of the existence and widths of the F-ring, and the Pioneer Division (also found recently by Pioneer).

The Pioneer Division separates the F-ring from the outer visible ring, the A-ring. The new, more-precise data shows that the F-ring is 2100 km (1300 mi) wide, compared with the 500 km width assigned to it by Pioneer optical observations.

Members of the Iowa team, in addition to Van Allen are Drs. Michelle Thompson and Bruce Randall, associate scientists; and graduate students Richard L. Rairden and Cynthia L. Grosskreutz.

The discoveries were made by what Dr. Van Allen calls "particle beam astronomy". This means that as high-speed sub-atomic particles mirror between Saturn's North and South Poles many times per minute, traveling precisely known paths through the planet's symmetrical magnetic field, they form a particle beam. The beam is much like that in a particle accelerator on Earth. As the particles are absorbed by moons and ring material, the beam is cut off. The "shadows" cast by moons and rings in the beam allow discovery of these objects. These "shadows"

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also can be used to measure size and position of moons and rings with instruments like the Iowa particle instrument.

Since the particles in a particular area are permanently absorbed, the shadow or cavity left under or over a moon or ring tends to last for hours--some distance along a moon's orbit, for example. Hence, this long-lasting shadow can be measured some time after passage of a moon.

The possible 13th moon of Saturn suggested by particle-beam measurements has been designated S-3, 1979, but data describing it can be interpreted in two ways, says Dr. Van Allen. Instead of a 13th moon outside Saturn's rings, the character of the particles themselves may be changing at this point. Work is going on to resolve this question. If it exists, the moon S-3 orbits 31,800 km (19,800 mi) outside Saturn's visible rings.

The new 12th moon, and the new ring were seen twice by the Iowa instrument aboard Pioneer, both approaching and leaving the planet.

In various Pioneer findings of rings and moons at Saturn, optical measurements have verified particle beam measurements, as with the F-ring and Pioneer Division. However, scientists are anxious to confirm the new ring region and moons when the Voyager spacecraft flies by Saturn in November 1980.

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NASA News

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IMMEDIATE

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SOLAR SYSTEM FORMATION MODELED

Could the Earth have formed in the middle of a giant protoplanet something like Jupiter?

Is the solar system, with its relatively small, rocky planets close to the Sun and large gaseous planets farther away from the Sun, typical of planetary systems around other stars?

Many scientists think the answers to both questions may be yes. Recent computer simulations strengthen this view, and include a major role for giant protoplanets.

For discovery of planets around other stars, and for charting the history of the solar system, the finding of answers to these questions is essential.

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December 3, 1979

A team of scientists at NASA's Ames Research Center, Mountain View, CA, has shown that giant protoplanets would have been orbitally stable in the early solar system. They also have developed a formula for determining sizes and positions of planets in planetary systems in general. They are now looking for likely arrangements of planets around other stars. These results will be presented on December 5 at the American Geophysical Union meeting, San Francisco.

One of the most frequent explanations of solar system formation is that at some time very early in the solar system's history a number of giant gaseous protoplanets revolved around the young and growing Sun. These giant protoplanets may have had the same mass as Jupiter, but were larger in size and hence more diffuse. The Ames researchers suggest that the rocky material in these giant protoplanets rapidly (in a few thousand years) fell to the center of the protoplanets, forming rocky cores. The mass of such a core would be comparable to the mass of the Earth.

The Pioneer Jupiter and Saturn spacecraft have produced evidence for the existence today of such rocky cores in the giant gas planets--Jupiter and Saturn.

As the Sun grew to its present mass by in-fall of material from the solar gas cloud, its gravitational field would have become stronger. Eventually, it would be strong enough to strip away the atmospheres of the giant protoplanets, leaving

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behind only their rocky cores. These remnant cores, it is argued, are the terrestrial planets.

If the Earth, Mars, and Venus are in fact remnant rocky cores of giant gaseous protoplanets like Jupiter, their protoplanets would have had to be stable for at least a thousand years.

The NASA-Ames team has shown that two Jupiter-mass protoplanets orbiting the Sun in the present-day orbits of Earth and Venus would, in fact, be stable for several thousand years. If the masses of the protoplanets were increased substantially (four times Jupiter's mass), then the one in Venus' orbit would have been ejected from the solar system in a few decades.

For these findings the team used a computer code designed to calculate accurately the orbital motions of a model planetary system. They also found that much more massive protoplanets (Jupiters in size) could have existed in stable orbits in the region of the outer gas giants, Uranus and Neptune.

A dramatic finding was that the orbits became unstable very suddenly. This meant catastrophic ejection of a planet from the solar system, with the body suddenly sailing off on a tangent trajectory. Earlier, Dr. P. E. Nacozy, University of Texas, had shown that an instability catastrophe might exist. Therefore, the team looked for a simple way to tell whether a particular type of planetary system would be orbitally stable.

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They ran numerical experiments in a large computer, a CDC 7600, to model several types of possible planetary systems. Surprisingly, they found that stability of planetary systems depends mainly on the ratio of orbit sizes (the ratio~~n~~ of their distances from the large parent body, the Sun). Stability is not affected by how close or how distant individual planets are from each other.

The Ames team now is attempting to develop a set of mass and orbit-ratio categories to describe planetary systems revolving around other stars than the Sun. No other planetary systems have yet been found, but sophisticated new methods of search are in planning stages.

Calculations, like those by the NASA-Ames team will help scientists to locate planetary systems around other stars, and to determine whether such systems occur frequently, or whether the solar system is a rare phenomenon.

Scientists who did this work are: D. C. Black, P. M. Cassen, and R. T. Reynolds, all of Ames, and F. R. Graziani, UCLA.

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HUGE CLUSTER OF GALAXIES SUGGESTED BY U-2 EXPERIMENTS

Using data obtained from high-flying NASA aircraft, scientists believe they may have discovered evidence for the largest cluster of galaxies--groups of hundreds of millions of stars--ever known.

And if the indirect evidence is correct, this means they have found a huge irregularity in the distribution of matter in the universe which seems to go back to the beginning, the original Big Bang.*

Scientists caution that the new evidence is exciting and that one explanation is a supercluster of galaxies. However, they emphasize that the findings are preliminary, and there are other possible explanations.

Evidence for the supercluster of galaxies, and hence for the huge irregularity, comes from analysis of measurements from NASA U-2 aircraft of the cosmic microwave background radiation left over from the Big Bang.

*The primordial explosion which many scientists believe began our universe.

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In 1978, a NASA-University of California at Berkeley team used the instrumented aircraft operated by NASA's Ames Research Center, Mountain View, Calif., to survey remnants of such radiation in the entire Northern Hemisphere sky. A similar survey of the Southern Hemisphere has just been completed.

The University of California scientists used this U-2 data to conclude that the Milky Way Galaxy--of which we are a part--is hurtling toward the constellation Virgo at more than a million miles an hour. This speed, which is much faster than expected, is attributed to the pull of the supercluster around Virgo.

The research group believes the supercluster contains 30 to 40 percent more galaxies than normally found in the same volume of space, and that it may stretch across some 2 billion light years of space.

When compared to the 10 billion-light-year-diameter of the observable universe, the supercluster would encompass 1 percent of the volume of it.

Dr. George Smoot of the University of California noted that not enough time has passed since the Big Bang for such a supercluster to have formed. This means that such a gigantic concentration of mass could go back to the beginning of the universe.

The surveys by NASA aircraft suggest that the event which started the universe about 10 billion years ago was extremely regular, that is, a powerful but tightly controlled expansion with matter moving outward in all directions at an equal rate.

Now comes the possibility of the supercluster and, "if we have one such huge concentration of matter," says Smoot, "there are probably others."

This implies that at the time of its formation, the universe was "lumpy"--that the primordial fireball itself was lumpy instead of being extremely smooth as measurements by the University of California researchers and others such as Rainer Weiss of the Massachusetts Institute of Technology and David Wilkinson of Princeton University had previously suggested.

The work of other astronomers has contributed to the suspicion of "something unusual in this part of the sky," Smoot said. X-ray astronomy studies by A. C. Fabian, Cambridge University, and R. S. Warwick, University of Leicaster, have found indications of a large-scale structure in the direction of Virgo. J. A. Tyson and J. F. Jarvis of Bell Laboratories have made automated counts of faint galaxies on long-exposure photographic plates and have found evidence of a northern supercluster of galaxies--far more than in any other part of the sky surveyed.

Scientists are surprised at the evidence for a cluster billions of light years in diameter. Said Smoot: "It boggles

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the mind that such a gigantic structure could exist--a big fraction of the observable universe."

Apparently there is only one such collection of mass relatively close to us. Others, however, may be found at great distances. Despite the possible existence of these large clusters, the mass of the universe appears, on the average, to be evenly distributed.

Smoot is somewhat disappointed that the finding could disrupt the pattern of a completely uniform Big Bang because a uniform universe history fits very well with recent work on subatomic particles.

"It is a paradox," he said, "that the universe is so uniform, but yet it appears to contain non-uniform structures on very close to the largest possible scale."

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Note To Editors: This report is also being released by the University of California.